

ISOETES IN SOUTHEASTERN UNITED STATES

by

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The genus Isoëtes as represented in Southeastern United States may be divided into two general groups: first, those species having megasporangia with irregularly crested or reticulate surfaces and growing nearly entirely as aquatics (rarely being amphibious) — as I. engelmannii A.Br. and its two varieties, var. caroliniana A.A.Eaton and var. georgiana Engelm.; and second, those species having megasporangia with tuberculate, pebbled or papillate surfaces and growing in wet prairies, wet sandy or rocky glades, granite pot-holes and in mud along tidal as well as non-tidal waterways (mainly coastal) — as I. riparia Engelm. ex A.Br. and its varieties, var. reticulata (A.A.Eaton) Proctor and var. palmeri (A.A.Eaton) Proctor (incl. forma saccharata (Engelm.) Proctor); I. virginica Pfeiffer and its var. piedmontana Pfeiffer; I. flaccida Shuttlew.; I. melanospora Engelm.; I. melanopoda Gay et Dur. and I. butleri Engelm.

Ecologically, Isoëtes engelmannii, the most widely distributed of the species studied, is aquatic, in fresh-water rivers, lakes and ponds on the Coastal Plain, in the Piedmont and in the Mountains; Isoëtes riparia, in the typical form, lives in fresh-water reservoirs and lakes in the Piedmont, barely reaching the upper limits of tidal areas, whereas var. reticulata and var. palmeri f. saccharata prefer the tidal rivers of the Delaware and Chesapeake Bays; Isoëtes virginica lives in fresh-water lakes and rivers on the Outer Piedmont in Virginia, North Carolina, South Carolina and Georgia, whereas var. piedmontana is confined to the acid granitic areas of North Carolina, South Carolina and Georgia; Isoëtes melanospora also prefers the acid granitic pot-holes in South Carolina and Georgia; Isoëtes flaccida lives in springs and in mucky areas along rivers, and barely reaches brackish areas on the Coastal Plain in Georgia and Florida; Isoëtes melanopoda and Isoëtes butleri are more interior species, only reaching eastward into the Mississippi River bottomlands from Iowa and Illinois, southward to Alabama and Louisiana, with I. butleri coming as far east as central Tennessee and western Alabama in the cedar glades.

Isoëtes melanopoda and Isoëtes butleri form a complex, even though the first is polygamous and the second, dioecious. Specimens

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collected on the same day, in the same place, with the same collection number, have been authoritatively named both ways. Even though extremes can be keyed out, many intermediate specimens confuse a description for either species. Most but not all specimens which can be named butleri live on limestone or in cedar barrens, whereas most but not all specimens which can be named melanopoda live on granite, quartzite, loess plains and the like. To the east Isoetes melanospora and I. virginica var. piedmontana prefer granite habitats, thus linking them to the melanopoda-complex.

Isoetes virginica var. virginica lives in muddy ponds, along creeks and rivers, in swamps in the Piedmont and Inner Coastal Plain areas. The southern form of this complex is I. flaccida in Florida and Georgia, giving rise to Isoetes virginica (typical) northward in Georgia, South Carolina, North Carolina and Virginia, up to the Blue Ridge Mountains; then coastal-wise being replaced by Isoetes riparia and its varieties from northeastern North Carolina and southeastern Virginia, up the Chesapeake Bay (palmeri) and the Potomac River (reticulata) to Piedmont Pennsylvania and then northward to Canada; and finally to confuse the issue thoroughly Isoetes engelmannii in its three forms, var. engelmannii, var. caroliniana and var. georgiana overlays the entire distribution of all these species.

Morphologically, there are several likenesses and differences which indicate these species form a complex.

First, the complete velum appears in I. melanospora which belongs more to the melanopoda-piedmontana-butleri-complex, yet in these species the velum is lacking or variously limited in size; and in I. flaccida which is a species more on the Coastal Plain, in flowing rivers, streams and the like, not too different from I. engelmannii var. georgiana and I. riparia var. riparia from further north.

Second, the megasporangia in I. engelmannii have a definite irregularly crested reticulation over the surface. In var. caroliniana and var. georgiana this reticulation becomes less distinct, more jagged or spiny with deeply cut margins. By the time one gets to southern Georgia and Florida, I. flaccida shows numerous flattish tubercles which may be distinct or may become confluent into labyrinthiform wrinkles. In I. melanospora the warts may be distinct or confluent; in I. melanopoda the tubercles are low, and more or less confluent, often united into wrinkles, or may be almost smooth; in I. butleri the tubercles may be distinct or confluent; and in I. virginica the ridges are irregularly marked with points and discontinuous ridges, not too different from some specimens of

I. engelmannii var. caroliniana and I. riparia var. riparia (which also has conspicuous jagged crests with sharp distinct or slightly confluent peaks). Also the quadrangular cross-section of the leaves in I. engelmannii and I. virginica link them closer together.

Third, in size I. engelmannii has leaves up to 6 dm. long, yet I have seen specimens from mountainous Virginia with very small leaves (2-4 cm. long), with mature megasporangia which are reticulate on all surfaces. In I. engelmannii var. caroliniana the leaves are shorter and stouter than in the typical variety, and tend to sprawl or sprawl. In I. engelmannii var. georgiana the leaves are fewer, more slender, 25-30 cm. long and the megasporangia are larger (480-560 μ) than in the other varieties (400-530 μ). In I. riparia var. riparia the leaves vary from 9-30 cm. in length, are usually straight and are rather rigid. The megasporangia have rather jagged crests forming irregular discontinuous ridges and occasional partial reticulations. Many specimens from Piedmont Maryland and Pennsylvania have been mis-identified as I. engelmannii, perhaps because of the reticulations, but the more rigid leaves are a more dependable character to rely upon in this species. I. flaccida has leaves 40-60 cm. long, although in some forms of I. flaccida the leaves are more slender and tend to be erect. The other species have relatively short leaves: in I. riparia var. palmeri (especially in forma saccharata) they vary from 6-15 cm. long and frequently are curved; in I. melanospora they are rarely over 6 cm. long; in I. virginica var. piedmontana the leaves are chiefly 7-12 (20) cm. in length, whereas in I. virginica var. virginica they may be up to 30 cm. long. In I. melanopoda the leaves are up to 45 cm. long, but in I. butleri they are rarely over 22 cm. long.

Other variables are: spotted, striped or unspotted walls of the sporangia; shape and size of the sporangia; polygamous or dioecious; peripheral strands in the leaves, varying from 4 to 6 to none; shape of the ligule; microspores spinulose, papillose or smooth; number of leaves per mature plant.

From the characteristics studied I think that there are three main species-complexes involved in Isoetes in Southeastern United States. Isoetes melanopoda is a mid-west genotype which extends eastward and is expressed by Isoetes butleri, Isoetes piedmontana and Isoetes melanospora. Isoetes engelmannii is a second genotype, more northern in origin, which is expressed by three varieties and Isoetes virginica and Isoetes flaccida. And a third genotype is Isoetes riparia, of more northeasterly origin, expressed by its various varieties. Isoetes virginica links I. engelmannii and I. riparia var. riparia, the extremes being I. riparia var. reticulata.

and I. riparia var. palmeri (incl. f. saccharata) on the one hand and I. engelmannii var. caroliniana and var. georgiana on the other. Isoetes flaccida with its various forms links I. virginica and I. riparia with I. engelmannii var. georgiana. However, I. flaccida with its complete velum, stands to the engelmannii-virginica-riparia-complex as I. melanospora stands to the melanopoda-piedmontana-complex.

The key below gives a rather complete description for each species or variety found in Southeastern United States. Several hundred sheets of Isoetes from this area have been annotated by me in the last ten years. Where there are unusual observations about a specimen, they will be mentioned in the annotated list given below. Undoubtedly, Isoetes is a difficult group, and I hesitate to lump the species and varieties simply because they are difficult to separate. Although many specimens have been collected, no attempt has been made to collect any one species in various phases of its growth from the same colony. I feel the key below tends to separate our Southeastern species of Isoetes in a fairly orderly manner.

Key to the genus Isoetes in Southeastern United States

1. Plants mostly aquatic (amphibious), submerged in water or along the margins of lakes, ponds, rivers and in ditches; megaspores with irregularly crested or reticulate surfaces.
 2. Leaves up to 100, or more, 1-6 dm. long, loosely spiralling and ascending to arching; 1-3 mm. wide at the middle, light green, quadrangular in cross-section, long-attenuate; peripheral strands usually 4; ligule triangular, 1 mm. long; sporangia oblong, 6-12 mm. long, pale, the wall mostly unspotted; velum very narrow, less than one-fourth covering the sporangium; megaspores 400-520 μ in diameter, with thin-walled honeycomb-reticulations, the ridges low and rounded; microspores 21-30 μ , smooth or nearly so. Amphibious in fresh-water situations, New Hampshire to Georgia, west to Indiana, Illinois and Missouri.....

.....1A. I. engelmannii var. engelmannii.
 2. Leaves fewer, up to 30 cm. long, more slender.
 3. Leaves 15-30, up to 22 cm. long, loosely spreading or sprawling; sporangia 6-8 mm. long, one-third to two-thirds covered by velum; megaspores 400-530 μ in diameter, the high honeycomb-ridges appearing jagged or spiny through the crisped and deeply cut margins; microspores 26-30 μ , densely muricate. Bottomlands, shallow exsiccated pools, pineland streams in southeastern

- Virginia and eastern coastal North Carolina, and in pools, lakes, bogs in upland North Carolina, South Carolina and Georgia.....1B. I. engelmannii var. caroliniana Eaton.
3. Leaves about 15, 25-30 cm. long, rather slender; sporangia oval, with narrow velum; megasporangia 480-560 μ in diameter; microspores 28-31 μ long, smooth. Mostly submerged, swamps, creek-banks in mucky soil or black mud, Eastern Coastal Plain to edge of Piedmont in North Carolina, South Carolina and Georgia.....
.....1C. I. engelmannii var. georgiana Engelm.
1. Plants usually growing in wet prairies, in wet sandy limestone or rocky glades, or in wet granite pot-holes, sometimes in mud along rivers; megasporangia with tuberculate, pebbled or papillate surfaces, occasionally with the tubercles confluent.
4. Velum complete; sporangia oval to orbicular.
5. Peripheral strands 4; leaves 10-35, light green, 4-6 dm. long, submerged or emersed; sporangia oval, 4-6 mm. long; megasporangia 300-420 μ in diameter, covered with numerous to few large flattish tubercles, these distinct or confluent into labyrinthiform wrinkles, light colored; microspores light brown, 26-33 μ long, slightly papillose. In lakes, ponds and along rivers, Florida and Georgia.....
.....2. I. flaccida Shuttlew.
5. Peripheral strands none; leaves 5-10, distichous, slender, light green, 5-6 cm. long; sporangia orbicular to nearly obcordate, 1-2 mm. long; megasporangia 350-450 μ in diameter, with distinct or confluent warts, dark colored; microspores 28-31 μ long, smoothish or slightly papillose. In shallow excavations or pot-holes in granite, Georgia and South Carolina....3. I. melanospora Engelm.
4. Velum incomplete or lacking; sporangia oblong.
6. Peripheral strands 4 (or 6), sometimes strongly developed, rarely absent; leaves 0.8-4.5 dm. long, 0.4-1.3 mm. wide at the middle; megasporangia tuberculate, the tubercles often confluent to form discontinuous ridges or crests, rarely almost smooth; microspores spinulose or papillose.
7. Leaves 8-30, 0.8-2.2 dm. long, pale or brown at the base; ligule narrow triangular to elongate.
8. Leaves 8-30, 0.8-2.2 dm. long, these triangular in cross-section, mostly 0.4-0.9 mm. wide at the middle; velum wanting or very narrow; ligule narrow-triangular, about 1 mm. long; sporangia 6-7 mm. long, usually brown-lineolate; megasporangia 480-650 μ in diameter, with distinct or confluent tubercles; microspores 27-37 μ long, papillose; plants dioecious. Terrestrial, growing in cedar barrens, limestone and alkali flats. Tennessee to Missouri, Arkansas, Kansas and Oklahoma.....
.....4. I. butleri Engelm.

8. Leaves 8-15, 1.5-3.0 dm. long, bright green, brown and shining at the base with narrow whitish margins, nearly quadrate in cross-section, mostly 0.4-0.6 mm. wide at the middle; velum covering one-fifth to one-third of sporangium; ligule elongate; sporangia broadly oblong, 3-4 mm. long; megasporangia 440-470 μ in diameter, irregularly marked with points and short discontinuous ridges; microspores 30-33 μ long, covered with spinules. Amphibious in meadows, in Piedmont and Coastal Plain, Virginia to Georgia.....
.....6. *I. virginica* Pfeiffer.
7. Leaves 15-60, 0.7-4.5 dm. long, dark chestnut-brown to blackish at base, rarely paler; ligule deltoid to narrow.
9. Leaves 1.2-4.5 dm. long, dark chestnut-brown at base, rarely paler (*f. pallida* (Engelm.) Fern.), mostly 1-1.3 mm. wide at the middle; velum narrow to broad; ligule deltoid, 1 mm. long; sporangia brown-spotted, 0.5-3 cm. long; megasporangia 280-440 μ in diameter, with low more or less confluent tubercles, often united into wrinkles, or almost smooth; microspores 23-28 μ , spinulose; plants polygamous. Amphibious, moist prairies, in overflowed fields, Iowa to Illinois, Missouri and Texas, Minnesota, South Dakota, (southern New Jersey).....
.....5. *I. melanopoda* Gay & Dur.
9. Leaves 0.7-1.5 (rarely 2.0) dm. long, slender, brown at the base; peripheral strands 4 or 6, or entirely lacking; sporangia brown with a narrow velum; megasporangia 400-480 μ in diameter, marked irregularly with low rough processes and short discontinuous ridges, sometimes branching; microspores 27-33 μ long, spinulose. In shallow granite outcrops on Piedmont, but some stations almost within the boundaries of the Coastal Plain, North Carolina, South Carolina and Georgia.....
.....7. *I. piedmontana* (Pfeiffer) Reed.
6. Peripheral strands absent; leaves 10-30, rather slender, 0.9-3 dm. long, 0.9-1.5 mm. wide at the middle, sharp-pointed, pale green; ligule minute, elongate; sporangia oblong, 3-8 mm. long, the wall brown-spotted or completely brown, covered one-fourth to one-third by the velum; megasporangia 440-660 μ in diameter, with conspicuous jagged crests with sharp distinct or slightly confluent peaks, sometimes giving a granular appearance; microspores 25-33 μ long, tuberculate, papillate or smooth.....8. *I. riparia* Engelm.

10. Megaspores with high, sharp, mostly irregular crests; leaves usually straight and rather rigid, 10-30, 9-30 cm. long; megaspores 440-660 μ in diameter, the crests on all faces irregular, crowded, tending to be confluent; microspores 25-33 μ long, tuberculate. Gravelly and muddy tidal and non-tidal, freshwater shores, reservoirs, Maine to New Jersey, Pennsylvania, Maryland and Delaware to South Carolina....
-8A. I. riparia var. riparia.
10. Megaspores with low crests, tubercles or ridges.
11. Outer face of megaspore low-reticulate; leaves straight, erect, rather rigid, few, 7-17 cm. long; megaspores 400-500 μ in diameter, the commissural faces low-granular, the outer face with inconspicuous low reticulations; microspores smooth. Tidal mud flats of Potomac River and its tributaries, near Washington, D.C.
-8B. I. riparia var. reticulata (Eaton) Proctor.
11. Outer face of megaspore with tubercles giving it a distinctly granular appearance; leaves 8-30, 6-18 cm. long, often recurved, though sometimes straight; megaspores 400-520 μ in diameter, the crests low and crowded; microspores 22-32 μ long, smooth or sparingly low-papillate or finely granular. Gravelly or muddy fresh to slightly brackish tidal shores, Chesapeake Bay, Delaware to District of Columbia and southeastern Virginia....
-8C. I. riparia var. palmeri (Eaton) Proctor.

1. ISOETES ENGELMANNII A.Br., Flora, 29: 178. 1846; Silliman's Jour. Sci. II, 3: 53. 1847; Baker, Jour. Bot., 18: 105. 1880; Motel. & Vendr., Linn. Soc. Bord., 36: 374, t. 12, f. 1-9. 1883; Pfeiffer, Ann. Mo. Bot. Gard., 9: 201-207. 1922; Reed, Bol. Soc. Brot., 2a ser., 27: 25. 1953.

Syn.: Calamaria engelmannii (A.Br.) Kuntze, Rev. Gen. Pl., 2: 828. 1891-93; Isoëtes engelmannii var. gracilis Engelm. in Gray's Manual, ed. 5: 677. 1876; Isoëtes engelmannii var. fontana Eaton, Fern Bull., 13: 52. 1905; in Gray's Manual, ed. 7, p. 61. 1908; Isoëtes engelmannii forma fontana (Eaton) Clute, Fern Allies, 258. 1905.

1A. ISOETES ENGELMANNII A.Br., var. ENGELMANNII. Map 1A(dots).

Missouri: St. Louis. D. Engelmann. (US-TYPE)

Alabama: Conecuh Co.: Wet woods, $2\frac{1}{2}$ mi. NE of Evergreen. Apr. 21, 1927. Harper #5. (US-1365880); Franklin Co.: Under sandstone cliffs. Harper 3399. (US-1632617); no county: Swampy place on Lookout

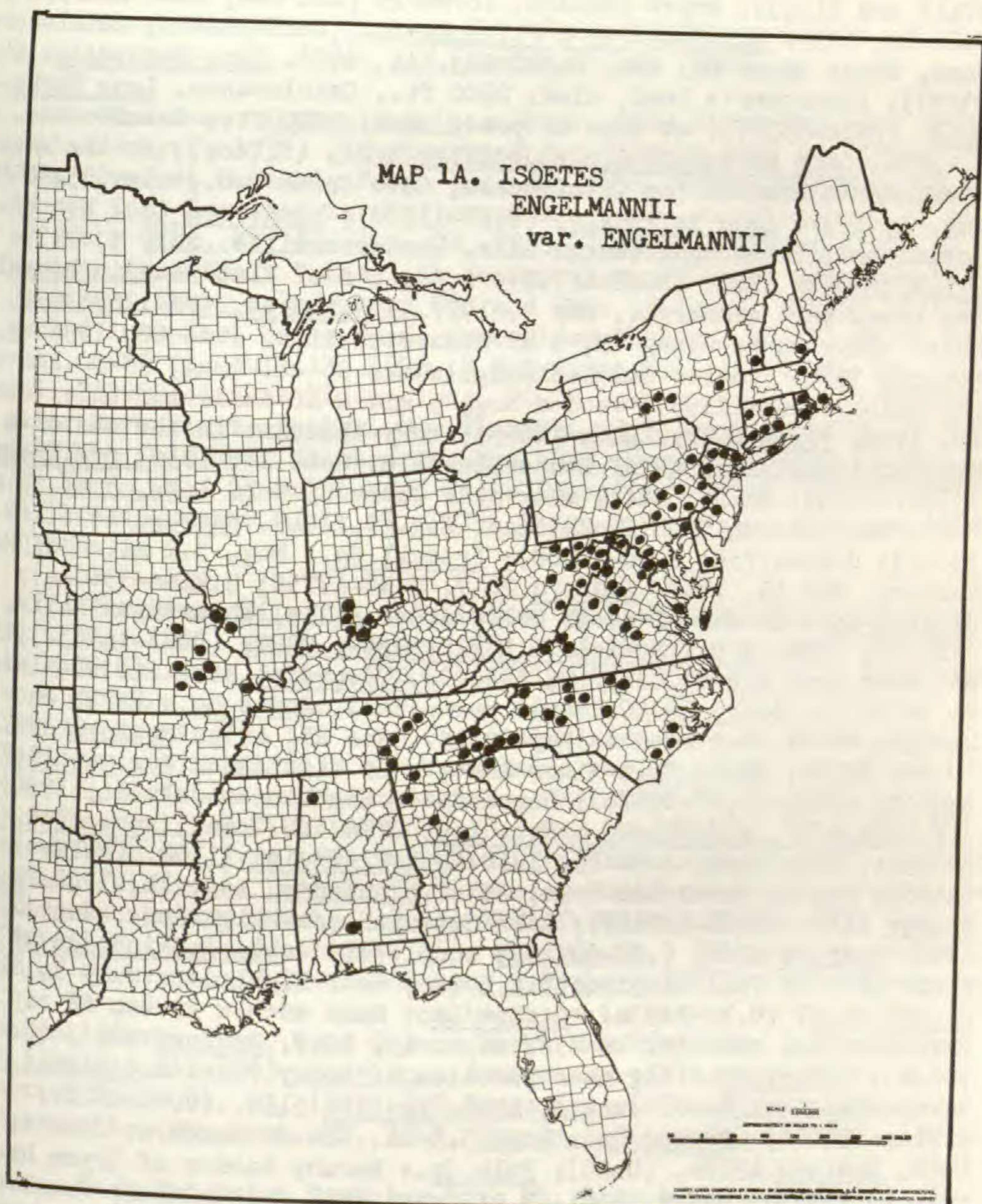
Mt. above Valley Head. May 22, 1899. Biltmore Herb. (US-724241).

Delaware: New Castle Co.: Delaware River. E. Hall ex Wm. Canby. (US-724235); Wilmington. Sept. 19, 1866. A. Commons. (US-154700); Wilmington, 1860. E. Tatnall. (GH); moist glade in woodland, pastured by cows, $\frac{1}{4}$ mi. SW of Ruthby Station. Sept. 21, 1947. Proctor 3100. (US-1917535); Staunton. June 1872. Wm. M. Canby. (GH- var. valida Engelm.).

Georgia: Floyd Co.: Lowland woods, Victory Lake, Mount Berry. June 16, 1939. Harold C. Jones. (UGa-19890); Jasper Co.: In running water of creek, draining "Flatwoods", $3\frac{1}{2}$ mi. S of Monticello, Piedmont Prov. Apr. 25, 1952. Wilbur H. Duncan 13420. (UGa-50693); meadow bordering Central of Ga. R.R. tracks, $3\frac{1}{2}$ mi. S of Monticello. Apr. 23, 1950. G.W. McDowell 594. (DUKE-138814 and UGa-52352); Fulton Co.: In pond, 1 mi. from Emory Univ. Campus. May 9, 1937. Don Eyles. (UGa-14126).

Maryland: Cecil Co.: Between tidal levels, gravelly and stoney east shore of Susquehanna River near its mouth, at Frenchtown. Sept. 7, 1948. Geo. R. Proctor 3605. (US-1917542); Montgomery Co.: Ditches along pathway near Great Falls. May 29, 1909. C.S. Williamson. (UConn.- var. valida); Prince Georges Co.: Border of pool in bottomland woods, NW of Snowdon Hall, Patuxent Research Refuge. July 10, 1941. F.M. Uhler & R.C. Erickson. (Fish & Wildlife Research Herb., Patuxent); Bottomland slough, Patuxent Research Refuge. June 2, 1937. Neil Hotchkiss 5175. (Fish & Wildlife Research Herb., Patuxent); bare bottom of bottomland run, Patuxent Research Refuge. June 24, 1938. Neil Hotchkiss 5909. (Fish & Wildlife Herb., Patuxent); Frederick Co.: Meyersville. Forrest Shreve 1797. (Plant Life of Md. - as var. valida); Garrett Co.: Crellin. Forrest Shreve 1903. (Plant Life of Md. - as var. valida).

North Carolina: Ashe Co.: Bares Pond, 2 mi. NE of Glendale Springs. Aug. 21, 1949. Radford 4939. (UMinn-536025; U.NC-50277; U.NC-47764); Caldwell Co.: Farm pond, 4 mi. N of Lenoir near Rt. NC 18. Aug. 23, 1949. Radford 4962. (U.NC-50265); Chatham Co.: Swamp forest, 4 mi. N of Merry Oaks. May 18, 1960. Radford 42861. (U.NC); Rt. 15-501, S of Mt. Carmel Church, road cut-off, E of Farrington Rd., near Clearwater Lake back to Chapel Hill. Apr. 22, 1949. (U.NC-47763); shallow pool, 3.5-4 mi. S of Chapel Hill. Apr. 22, 1949. Radford 3081. (U.NC-50318); Forsyth Co.: Weavers Lake near Rt. 421, W of Kernersville. Aug. 23, 1949. Radford 4964. (U.NC-50217); Granville Co.: Swamp forest, 8 mi. NE of Granville-Wake Co. line, on Rt. US 15. Apr. 17, 1956. Radford 10483. (U.NC); Guilford Co.: On R.M.Causey Farm, Liberty. May 9, 1937. Lane Barksdale. (U.NC-13137 and 94205); Haywood Co.: Medford Pond, Lake Junaluska. June 28, 1931. H.L.Bломquist 1709. (DUKE-11311); pool on Big Cataloochee River, Great Smoky Mt. Nat. Park. July 11, 1939. H.C.Bold. (DUKE-



57113 and 11323); moist lowland, formerly pond bed, near Medford Farms. June 20, 1935. M.E.Humphrey & F.T.Rome 54. (DUKE-32889); Cataloochee Pond, Great Smoky Mt. Nat. Park. Aug. 14, 1936. Lane Barksdale. (U.NC-13139); Alexander's Pond, elev. 2200 ft., Cataloochee. Lane Barksdale. (DUKE-35077); at edge of pond, elev. 2500 ft., Cataloochee. Aug. 1, 1936. Lane Barksdale & H.M.Jennison 3222. (U.Tenn); on the edge of Alexander's Pond in the Cataloochee, Cove Creek P.O., elev. 3400 ft. Aug. 1, 1937. Lane Barksdale. (U.NC-13138); Henderson Co.: Wet alluvial soil below dam, Kanuga Lake, Hendersonville. July 5, 1937. H.L.Bломquist 9701. (DUKE-42752); 1.5 mi. S of Flat Rock in brooklet, the basal part submerged. May 3, 1927. E.T.Wherry. (US-1289439); moist shady woods along RR, N of Hendersonville. June 28, 1936. H.J.Oosting 3676. (Butler Univ.-31699, leaves 36 cm. long, 15-20 leaves per plant; U.Ga-11585); wooded bog, 5 mi. N of Hendersonville. June 28, 1936. Pyron-NC78. (U.Ga-12095); very abundant in the mud of a drained lake, 3 mi. SW of Hendersonville. Oct. 17, 1953. O.M.Freeman 53590. (U.NC; REED); black muck near shore of Wolf Lake, 5 mi. W of Hendersonville on Crab Creek Road. Aug. 9, 1949. Radford 4838. (U.Minn-536023; U.NC-47756; U.NC-50268); Iredell Co.: Bog, 3.2 mi. W of Harmony. May 14, 1949. Radford 2647. U.NC-47758; U.Minn-536014); Jackson Co.: In mud of shelf below upper falls, Whitewater Falls. July 25, 1958. W.B.Schofield & R.M.Schuster 9381. (DUKE-145652); Sunset Camp near Wilmot. July 9, 1936. J.E.Benedict 3441. (U.ND- leaves up to 40 cm. long, 30-40 leaves per plant); Jones Co.: Marsh on Hunting Creek near road to Maysville. June 27, 1951. Radford 5877. (U.NC; REED); Macon Co.: Minor Lake, W of Highlands. Aug. 4, 1949. Radford 4788. (U.NC-50326); Horse Cave, Highlands. July 14, 1934. J.K.Underwood, M.B.Wilson & Mrs. Lott 2796. (U.Tenn); submerged, Lake Sequoia, Highlands. June 15, 1940. H.L.Bломquist 11108. (DUKE-64405); bog in Horseshoe Cove, SE of Highlands. Aug. 11, 1948. R.L.Wilbur 1160. (DUKE-126169); Lake Sequoyah near Highlands. Aug. 4, 1948. Radford 4786. (.NC-50325); completely submerged in edge of Minor Lake by Bill Lippincott's house, near Highlands. July 14, 1939. Harold Bold. (U.NC-11334); Onslow Co.: Bank of New River, SW of Jacksonville, near Rt. US 258. Sept. 13, 1949. Radford 5053. (U.NC-50528); Pender Co.: Bog near junction of Rocky Point and Castle Hayne-Hampstead Road. June 1, 1950. Radford 5150. (U.NC-49259; U.Minn-536008); Person Co.: Bog, 3.3 mi. SSW of Roxboro. June 2, 1960. Radford 43196. (U.NC); Polk Co.: Marshy border of Tryon Reservoir in shallow water, 4 mi. W of Tryon Fall Creek Gulch, Pacolet River Valley, elev. 600 m. June 19, 1942. F.R.Fosberg 18920. (U.NC-28242); Rowan Co.: Peeler's Lake near Rt. US 52, N of Granite City. Aug. 19, 1949. Radford 4912. (U.NC50278 and 47757); Stokes Co.: Lake at Hanging Rock State Park. May 12, 1948. Radford 3065. (U.NC-35331); Swain Co.: Wet places, elev. 1700 ft. July 20, 1891. H.C.Beardslee. (U.West. Ont. Herb.- 12761); Aug. 1891. H.C.Beardslee. (U.Minn-55696); Transylvania Co.: Roadside ditch at Balsam Grove. July 2, 1957. O.M.Freeman 57495. (U.NC; REED); in RR ditch near water tank, SW of Rosman. Summer 1923. H.L.Bломquist 1707. (DUKE-25265); Lake Segga, N of Rt. US 64 near Brevard. Aug. 8, 1949. Radford 4825. (U.NC-50330).

South Carolina: Pickens Co.: Springhead bog, 1.5 mi. E of Pickens. Sept. 22, 1956. O.M.Freeman 56758. (U.NC).

Tennessee: Cumberland Co.: Water, Obed River dam near Crossville. July 7, 1935. J.K.Underwood & A.J.Sharp 2855 and 3860. (U.Tenn) Obed River at Potter's Ford. Aug. 31, 1955. Frank Robinson. (U.Tenn); Grundy Co.: Immersed in shallow water of old swimming pool, 2 mi. S of Tracy City, Rt. 56. Aug. 28, 1943. Jamison & Shaver 4160. (U.Tenn); Jackson Co.: Shady Valley, in swamp, elev. 2800 ft. May 20, 1934. Jennison, Sharp & Underwood 763 and 860. (U.Tenn); Marion Co.: Submerged in water, Snake Pond, Cumberland Plateau, 10 mi. SE of Sewanee, elev. 1800 ft. July 13, 1938. H.K.Svensen 9511. (U.Tenn; Cal. Acad. Sci. 283708- leaves 70 cm. long, 20-25 leaves per plant); Morgan Co.: Clear Fork River, Rugley. May 31, 1934. H.M.Jennison 1118. (U.Tenn); Sullivan Co.: Near Holston Mt. May 1938. Herman O'Dell. (U.Tenn); Van Buren Co.: In moist sand above Cane Creek Falls, between Pikeville and Spencer. July 19, 1935. Sharp & Underwood 2839 and 4009. (U.Tenn).

Virginia: Giles Co.: Salt Pond Mt., Mountain Lake, elev. 4000 ft. Aug. 1890. Wm. M. Canby. (GH; US - as var. valida); growing in Mountain Lake, elev. 4000 ft. July 17, 1932. E.L.Core 4281. (UWVa); edge of lake, Mountain Lake. Aug. 15, 1934. H.L.Bломquist 3467. (DUKE-23958); growing in the lake, Mountain Lake. July 16, 1935. Velma Matthews. (U.NC-94206); Mountain Lake. Aug. 6, 1953. Wm. Cross. (UGa-60601); south end of Mountain Lake, Salt Pond Mt. July 22, 1956. R.F.Thorne 11313. (DUKE-137616; U.Iowa; UGa-56477); Salt Pond Mt., elev. 3870 ft., vic. Mt. Lake Biol. Station. Aug. 1, 1958. H.Iltis 19810. (U.Wisc.); Roanoke Co.: Forming solid stands in shallow open water in springy marsh, 3.5 mi. WSW of Salem P.O. July 12, 1946. Carroll E. Wood, Jr. 6190. (US); Madison Co.: Big Meadows Swamp, 4 mi. SE of Marksville, elev. 1040 m. F.R.Fosberg 34911. (US); Middlesex Co.: In mud at waters edge and in pools in swampy woods, along Piankatank River, 2 mi. N of Glens Fork. May 29, 1921. E.C.Leonard & E.P.Killip 34. (US); Page Co.: Headwaters of Passage Creek, Massanutten Mts. Oct. 21, 1951. G.R.Fessenden. (US); Shenandoah Co.: Massanutten Mt. Sept. 21, 1941. Chapin & Fessenden. (US).

West Virginia: Berkeley Co.: Mt. Lake Lodge, Hedgesville. Sept. 16, 1945. H.Ison Shreve. (UWVa); Grant Co.: East side along a drain in wet field, Top of Alleghany Forest along Rt. 42, Scherr. July 19, 1942. H.I.Shreve. (UWVa); Hampshire Co.: Growing in mountain bog, Short Mt. Aug. 20, 1940. W.M.Frye & H.A.Davis 3459. (UWVa); Hardy Co.: Cacapon River. Aug. 1931. P.D.Strausbaugh. (UWVa); Mineral Co.: In a ditch, Sugar Camp, Kitzmiller's Farm, Sulphur. Aug. 1953. Melvin Brown. (UWVa); Monongalia Co.: Along edge of Tibbs Run Reservoir. Aug. 13, 1946. E.A.Bartholomew 53. (SABC-7th Dist., 603; UWVa; US; UGa-31719; TEX-38939; Univ. Coimbra Portugal; U.NC-138019; U.Tenn); Morgan Co.: Spruce-pine Hollow, along Rt. 9. July 3, 1942. H.I.Shreve. (UWVa); close shady Grove Park, Berkeley Springs. July

7, 1937. Ralph Barton. (Cal. Acad. Sci.-283720); Pocahontas Co.: Thornwood. July 12, 1939. Mr. & Mrs. H.A. Davis 2606. (UWVa-plant with 131 green leaves); Preston Co.: Deep Hollow. June 1942. Charles Peck. (UWVa); Three Forks Creek. June 6, 1939. Mr. & Mrs. H.A. Davis 2604. (UWVa-plant with 127 green leaves); Taylor Co.: On exposed stony muddy shore of Tygart River, near Cecil. July 11, 1937. Neil Hotchkiss 4632. (Fish & Wildlife Service, Patuxent; US); Tucker Co.: In mountain bog between Thomas and Parsons. Aug. 5, 1950. Mr. & Mrs. H.A. Davis 9251. (UWVa); Upshur Co.: Kanawha Head. Sept. 1, 1937. Mr. & Mrs. H.A. Davis 1247. (UWVa); Buckhannon River. July 20, 1933. P.D. Strausbaugh. (UWVa-megaspores reticulate in some specimens, not reticulate in others; intermediate with var. caroliniana).

1B. ISOETES ENGELMANNII var. CAROLINIANA Eaton, Fern Bull., 8: 60. 1900; Pfeiffer, Ann. Mo. Bot. Gard., 9: 207. 1922; Broun, Index North Amer. Ferns, 100. 1938; Reed Bol. Soc. Brot., 2a ser., 27: 25-26. 1953. Map 1B(dots).
Syn.: Isoetes engelmannii forma caroliniana (Eaton) Eaton, Fern Bull., 11: 25. 1903; Clute, Fern Bull., 19: 55. 1908.

Georgia: DeKalb Co.: Along margin of Durand Pond, submerged. May 9, 1937. Don Eyles 1882. (DUKE-49818); Putman Co.: In 3 in. of water in wooded bottomland along Gladys Creek, 5½ mi. NE of Eatonton in area called The Glades. Apr. 11, 1948. W.H. Duncan 7916. (US-2019419; UGA-50694); Rabun Co.: In shallow water of boggy area in White Pine-Rhododendron-Kalmia growth of Glades area. Aug. 14, 1949. W.H. Duncan 10101. (UGA-50695); Richmond Co.: Sandy bog, Augusta. July 20, 1901. A.Cuthbert 572. (U.Conn.).

North Carolina: Alexander Co.: Bog, 1 mi. N of Schneider's Mill near Taylorsville. Sept. 5, 1949. Radford 4973. (U.NC-50531); Alleghany Co.: Shallow water in Lake Louise at Roaring Gap. Aug. 21, 1949. Radford 4926. (U.NC-50333); shallow water at the State Fish Hatchery, Roaring Gap. Aug. 21, 1949. Radford 4930. (U.NC-50215); same loc., May 14, 1949. Radford 4069. (U.NC-50322 and 47759); Avery Co.: Pools in creek bottom, 2.4 mi. SW of Frank, on Rt. 19E. July 24, 1959. H.E. Ahles 47426 with J.A. Duke. (U.NC); submerged, artificial lake between Linville and Montezuma Gap. Sept. 17, 1938. H.L. Blomquist 10490. (DUKE-50418); submerged in Wildcat Lake, SW of Banner Elk. Sept. 5, 1949. Radford 4975. (U.Minn-535988; U.NC-47766 and 50275); Beaufort Co.: Stream bank, near Rt. NC 33, 2 mi. WNW of Cox's Crossroads. May 17, 1958. Radford 33325. (U.NC; REED); Buncombe Co.: In cold boggy places near base of Craggy Mt. May 19, 1898. Biltmore Herh.-5564B. (US-335540); Cherokee Co.: Pool in old limestone quarry, N of Marble. Aug. 6, 1949. Radford 4810. (U.NC-50327); Clay Co.: Bog, Chatuge Lake, 3.5 mi. E of Hayesville. Aug. 21, 1956. Radford 16329. (UNC); abundant in temporary roadside pool, near Buck Creek Bridge on Rt. US 64. Aug. 5, 1949.

Radford 4698. (U.NC-47762 and 50271); small pool and bog, 12 mi. E of Hayesville near Rt. US 64. Aug. 5, 1949. Radford 4799. (U.NC-50270); Carroll Lake, 1.5 mi. SE of Mission. Aug. 22, 1952. Radford 6427. (U.NC-51927); Gaston Co.: Swamp, $\frac{1}{2}$ mi. N of Steppes Gap, Kings Mt. June 12, 1934. E.T.Wherry. (UWVa; DUKE-24136); Graham Co.: Bog on Rock Creek, 1.5 mi. S of Robbinsville. Aug. 6, 1949. Radford 4813. (U.NC-50328); Haywood Co.: Pool on Big Cataloochee River. July 17, 1939. Harold Bold. (U.NC-11323); Henderson Co.: Moist shady woods along RR, N of Hendersonville. June 28, 1936. H.J.Oosting 3676. (DUKE-35406); Iredell Co.: Wet places in bog, 3 mi. NW of Harmony, N side of Rt. 901. June 8, 1955. Blomquist et al. 16633. (DUKE-160858); in wet boggy soil, below bog, 2 mi. W of Union Grove, Rt. 901. June 8, 1955. Blomquist et al. 16650. (DUKE-160861); Jackson Co.: Upper lake at High Hampton near Cashiers. Aug. 8, 1949. Radford 4820. (U.NC-50329); muddy bottom around margin of Cashiers Lake. Aug. 2, 1949. Radford 4754. (U.NC-47760 and 50274); Lake Sapphire near Cashiers. Aug. 3, 1949. Radford 4772. (U.NC-50274); Macon Co.: Muddy bottom of Country Club Lake, Highlands. Aug. 4, 1949. Radford 4778. (U.NC-47767 and 50272); McDowell Co.: State Fish Hatchery pool at Marion. Aug. 18, 1949. Radford 4884. (U.NC-50279); Mitchell Co.: Roandale Farm. Aug. 1, 1895. A.G.Wetherby 135. (US-273397); edge of fish-pond, half-submersed or less, gravel bottom. Aug. 15, 1898. A.G.Wetherby. (U.Minn-55697, "Cotype" on sheet). Acc. to Pfeiffer, near Salisbury; muddy bands or partly in water, headwaters of Big Rock Creek, Magnetic City. Aug. 15, 1898. A.G.Wetherby. (U.NC-13140, 94204, 94203). See Blomquist, Amer. Fern Jour., 21: 90. 1931; Wetherby Place, Big Rock Creek, Roan Mt. Aug. 1893. W.W.Ashe. (U.NC-24428); Estes Pond, 1.5 mi. S of Spruce Pine on Rt. NC 26. Radford 4958. (U.NC-50266); Polk Co.: In bogs formed by cold springs on Spring Mt., near Columbus, elev. 3000 ft. May 5, 1897. Biltmore Herb. 5564. (US-331006; U.Minn-55694); Rutherford Co.: McCall's Lake, near Rt. NC 26, 2 mi. E of Burke Co. line. Aug. 18, 1949. Radford 4896. (U.NC-50332); Transylvania Co.: Rockhouse Camp Pool, 4 mi. S of Brevard. Aug. 8, 1949. Radford 4827. (U.NC-50269); Union Co.: Low wet cornfield, 1 mi. S of Stanley-Union Co. line, Rocky River, 4 mi. N of Unionville. May 3, 1956. Ahles 12028 and Radford. (U.NC; REED); Watauga Co.: Snyder's Lake, Blowing Rock. Aug. 22, 1949. Radford 4945. (U.NC-50267); Yancey Co.: Bog on Rt. NC 197, 1 mi. N of Pensacola. Aug. 22, 1949. Radford 4957. (U.NC-50216 and REED; U.NC-47765).

South Carolina: York Co.: Rush swamp in pasture, 2.5 mi. S of junction Rt. SC 274 and Rt. SC 577, 6.8 mi. N of Newport. April 14, 1957. Ahles 22947 and Haesloop. (U.NC).

Virginia: Dinwiddie Co.: Richwoods along Cattail Run, SE of Burgess Station. May 21, 1939. M.L.Fernald and Bayard Long 9797. (DUKE-60852; US; UWVa); Greenville Co.: Fontaine Creek, SE of Taylors Millpond. June 12-13, 1939. M.L.Fernald & B. Long 10079. (US); Southampton Co.: Forming carpets, argillaceous and siliceous

alluvium, bottomland of Nottaway River, near Courtland. June 23, 1936. Fernald, Long & R.F. Smart 5589. (U.Minn-450554; U.Wisc.; US); sandy alluvial bottomlands of True Creek, Drewryville. June 22-23, 1936. Fernald, Long & Smart 5589. (US); Cypress Bridge on Nottaway River. July 25, 1936. Fernald & Long 5974. (US); Sussex Co.: In silt of bed of brook, woods by Nottaway River, SW of Lambs. July 18, 1940. Fernald & Long 12222. (U.Ga-26580; US; GH); wooded bottomland, Jones Hole Swamp, W of Cddyshare. June 18, 1939. Fernald & Long 10081. (Cal. Acad. Sci.-283709; US); wooded bottomland, Tree Creek, SW of Grizzard. June 14, 1939. M.L. Fernald & B. Long 10080. (US).

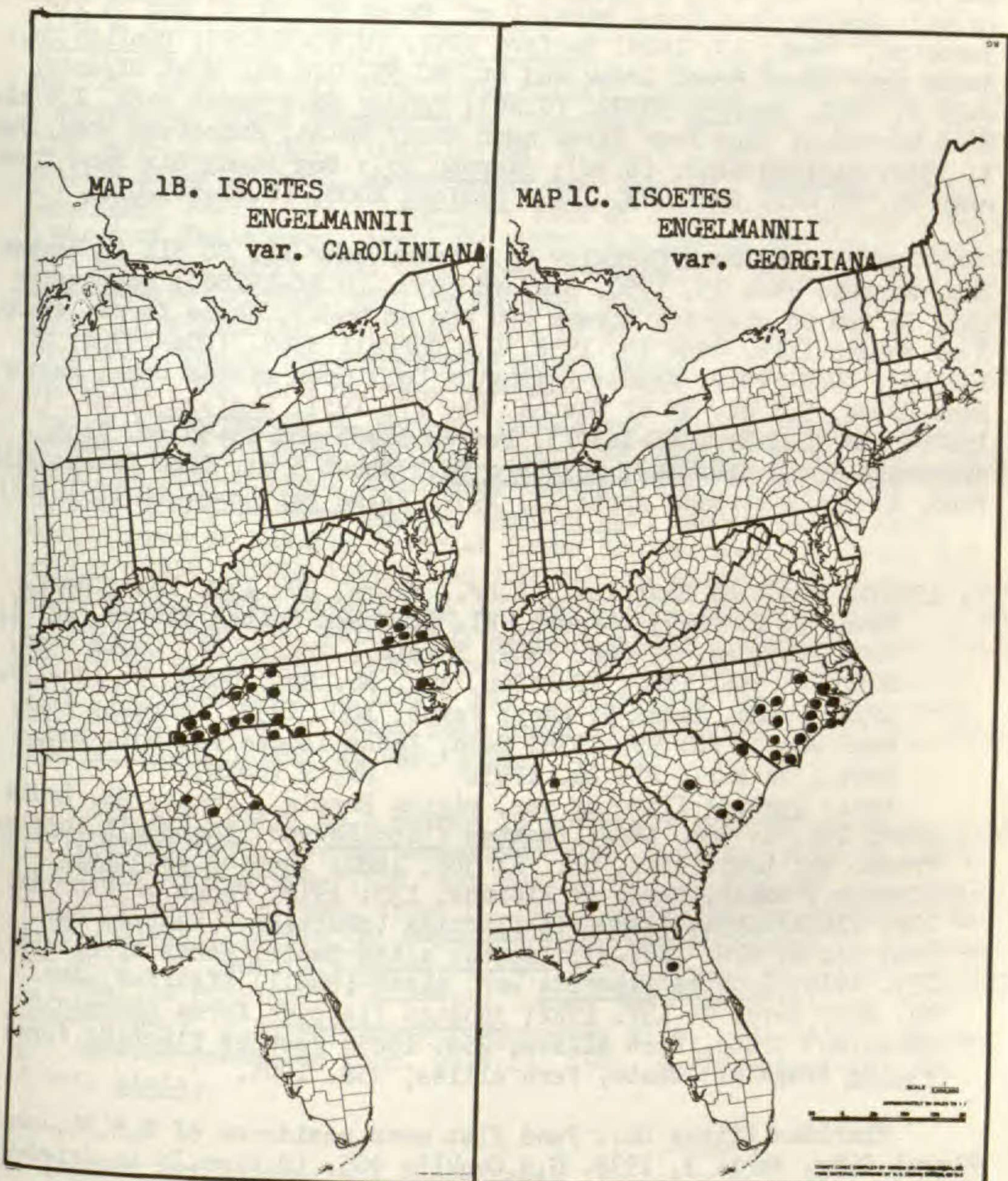
1C. ISOETES ENGELMANNII var. GEORGIANA Engelm., Trans. St. Louis Acad. Sci., 4: 384. 1882; Reed, Bol. Soc. Brot., 2a ser., 27: 26. 1953. Map 1C(dots.).

Syn.: Isoëtes engelmannii forma georgiana (Engelm.) Clute, Fern Allies, 258. 1905.

Florida: Alachua Co.: In shallow water in margin of Sugarloaf Prairie near Gainesville. Jan. 6, 1947. Erdman West. (UGa-30783).

Georgia: Baker Co.: Common in up to 2 ft. of water in sluggish Big Cypress Creek, mostly submersed, elev. 130 ft. July 17, 1946. R.F. Thorne 1566. (UGa-24223; U.Tenn); Whitford Co.: Clayey soil in wet woods, eastern base of Taylor's Ridge, elev. 110 ft. July 26, 1900. Roland M. Harper 310. (US-384214); Floyd Co.: Mountain stream, Horseleg Creek, a tributary of Coosa River. A.W. Chapman. (TYPE).

North Carolina: Beaufort Co.: Stream on Chocowinity Creek, 5 mi. SE of Chocowinity. May 17, 1958. Radford 33304. (U.NC); Bladen Co.: Brown Swamp near Rt. US 701. June 14, 1950. Radford 5306. (U.NC-49285); Brunswick Co.: Sluggish stream, 0.6 mi. SE of Bolivia. June 2, 1950. Radford 5187. (U.NC-49258; in mud of slough in swamp, between Waccamaw River and Ash. June 2, 1937. D.S. Correll & H.L. Blomquist 7366. (DUKE-71279); moist mucky soil, Lockwood's Folly, E of Supply. July 11, 1960. Mrs. Forrest et al. (DUKE-145721); black mud on stream bank, 0.4 mi. SW of Supply. June 2, 1950. Radford 5178. (U.NC-49256; U.Minn-536010); black mud on creek bank, 4 mi. W of Winnabow. June 2, 1950. Radford 5176. (U.NC-49257); Carteret Co.: Marsh on creek, 4 mi. S of Kuhns. June 27, 1951. Radford 5873. (U.NC); Columbus Co.: Boat Landing, Livingston Creek near Freeman. Sept. 1932. Miss. Gertrude Grimsley. (DUKE-11310); swamp near Rt. NC 130, 5 mi. SE of Old Dock. June 14, 1950. Radford 5323. (U.NC-49287); Craven Co.: Batchelder Creek near Rt. US 70. June 12, 1949. Radford 4435. (U.NC-50324); Core Creek near Rt. US 70. June 12, 1949. Radford 4432. (U.NC-50323); Edgecomb Co.: Stream bank near Rt. NC 43, 3 mi. W of Pinetops. May 27, 1958. Radford 34021. (U.NC); Harnett Co.: Moores Creek near Rt. NC 53. April 23, 1949. Radford 4013. (U.NC-50321); Johnston Co.: Black muddy creek bank, 2 mi. N of Smithfield near Wilson Mills Road. May 19, 1950. Radford 5132. (U.NC-49271); Jones Co.: Bank of White



Oak River, 5 mi. N of Haywood Landing. June 28, 1951. Radford 5886. (U.NC); Onslow Co.: Creek bank, 1 mi. NW of Rt. NC 53 and US 258 junction. Sept. 13, 1949. Radford 5051. (U.NC-50529); Pamlico Co.: Swamp near Upper Broad Creek and Rt. NC 55, 0.6 mi. W of Olympia. July 5, 1958. Radford 35792. (U.NC); Pender Co.: Creek bank, 1.6 mi. E of Northeast Cape Fear River near Rocky Point, Hampstead Road. June 1, 1950. Radford 5147. (U.NC); Sampson Co.: Bog along Six Runs Creek near Rt. US 421. April 23, 1949. Radford 4008. (U.NC-50320).

South Carolina: Berkeley Co.: Swamp near Rt. SC 511 in Santee Exp. Forest. June 15, 1950. Radford 5337. (U.NC-49286); Dorchester Co.: In mud in stagnant stream bed and on banks, dense forest swamp, S of Summerville. June 16, 1936. D.S.Corrill 5367. (UGa-15704; US-1727433; DUKE-37019; REED); Lexington Co.: Open stream bank, Savany Hunt Creek, 3.5 mi. NE of Gaston. May 27, 1957. Radford 23387. (U.NC-154298 and 102228; DUKE-143013, leaves 50-55 and 45-55 cm. long, sporangia brown spotted); Marlboro Co.: About 5 mi. from Drakes Mill Pond, in small stream. April 12, 1939. Velma Matthews. (U.NC-10362).

2. ISOETES FLACCIDA Shuttlew.; A.Br., Flora, 29: 178. 1846; Amer. Jour. 3: 2. 1847; Chapman, Fl. Southern United States, ed. 1, 602. 1860; ed. 2, 602. 1889; Engelm., Trans. St. Louis Acad. Sci., 4: 386. 1882; Pfeiffer, Ann. Mo. Bot. Gard. 9: 136-138. 1922; Broun, Index N. Amer. Ferns, 100. 1938; Correll, Amer. Fern Jour., 28: 99. 1938; Reed, Index Isoetales, Bol. Soc. Brot., 2a ser., 27: 26. 1953. Map 2 (dots).

Syn.: Isoetes flaccida var. rigida Engelm., Trans. St. Louis Acad. Sci. 4: 386. 1882; Isoetes flaccida var. chapmanii Engelm., Trans. St. Louis Acad. Sci. 4: 386. 1882; Isoetes chapmanii (Engelm.) Small, Ferns of Florida, 133. 1918; Ferns of Florida, 222. (1931) 1932; Calamaria flaccida (Shuttlew.) Kuntze, Rev. Gen. Pl. 2: 828. 1891-93; Isoetes alata Small, Ferns of Florida, 133. 1918; Isoetes flaccida var. alata (Small) Pfeiffer, Ann. Mo. Bot. Gard. 9: 137. 1922; Isoetes flaccida forma chapmanii (Engelm.) Clute, Fern Allies, 258. 1905; Isoetes flaccida forma rigida (Engelm.) Clute, Fern Allies, 258. 1905.

Florida: Citrus Co.: Pond flat near residence of R.R. St. John, Floral City. April 3, 1938. G.H.Conklin 905. (U.Wisc.); in dried-up pond about $\frac{1}{2}$ mi. E of Floral City. April 6, 1938. R.T.Clausen & H.Trapido 3339. (Penn State- as var. alata); Dade Co.: In hammocks between Cocoanut Grove and Cutler. Nov. 13-23, 1903. J.K.Small & J.J.Carter. (NY; U.Minn-260860); Duval Co.: Jacksonville. (US); Franklin Co.: Frequent locally on sandy-muck and shallow standing water of apalachicola River bank, 1-3 mi. N of RR bridge crossing, NW of Apalachicola. June 29, 1956. R.Kral & P.L.Redfearn 2744. (DUKE; REED); Hernando Co.: Growing in dense patches in a few inches of water, firm sand bottom in shallow pond, near Rt. US 98, 7 mi.

SE of Brooksville. May 7, 1954. F.M.Uhler & Neil Hotchkiss 7409. (Fish & Wildlife Research, Patuxent; REED); frequent, submersed in 2.5 ft. of slowly flowing clear water, 0.5 mi. E of Brooksville. Aug. 24, 1938. R.Kral 7978. (UGa-60156); Jackson Co.: Inundated in a spring-run along Chipola River, Marianna. May 11, 1956. R.K.Godfrey 54782 & H. Kurz. (DUKE-165768; U.Tenn); Jefferson Co.: In shallow water of pool, sandy woods near Newport. April 10, 1961. E.J.Palmer 38493. (US); Leon Co.: Bank of drain from Munson's Pond, 7 mi. S of Tallahassee. April 19, 1925. R.M.Harper 22. (US); Manatee Co.: Manatee. April 1878. A.P.Garber. (US;UWVa); Pinellas Co.: Way-side Aquatic Gardens, 3515 Obispo St., Tampa. Mar. 16, 1936. Manuel Nosti. (U.NC-94207); brackish banks of Hillsboro River, N of Hillsboro Ave., Tampa. Dec. 11, 1935. Manuel Nosti. (U.Fla; U.NC-146172); Sumter Co.: Wet pine barrens, in 1-2 in. water, Eocene formation. July 5, 1905. Roland M. Harper. (US-as var. rigida); 4 mi. NE of Coleman. July 9, 1938. Phillips, Woodbury, Buswell & St.John. (US); margin of shaded pond, Riverland. July 23, 1900. A.H.Curtiss 6696. (U.Minn-55707, as var. alata); Wakulla Co.: Amphibious in peaty muck, shores of Wakulla River at Lower Bridge. June 27, 1955. R.K. Godfrey 53538. (DUKE-136114 and 160529); in shady sandy mucky bottom, Newport, St. Marks River. Aug. 11, 1933. Neil Hotchkiss 4514. (Fish & Wildlife Research, Patuxent); Without county indicated: Lake Flint. Aug. 1878. A.P.Garber. (Univ. Coimbra; US); open miry places, in Turnbull Swamp, Halifax River. May. A.H.Curtiss 3813. (Cal. Acad. Sci.-187082); edge of swamp near canal, Palm Valley. April 26, 1940. Mary W. Diddell. (US, as var. alata).

Georgia: Baker Co.: Common in up to 2 ft. of water in sluggish Big Cypress Creek, mostly submersed, elev. 130. ft. July 17, 1946. R.F.Thorne 1566. (UGa-37558, not UGa-24223); Bullock Co.: In sluggish pine barren stream. June 10, 1901. Roland M. Harper 843. (US-as var. alata); Coffee Co.: Sluggish pine barren stream, E of Douglas. July 19, 1901. R.M.Harper 1429. (US); Laurens Co.: (US); Miller Co.: Shallow running water of Big Drain, just above Babcock Pond. Mar. 23, 1949. R.F.Thorne & W.C.Muenscher 9114. (UGa-38329); Sumter Co.: Cypress pond near Cobb. July 11, 1901. R.M.Harper 1046. (US, as var. alata).

3. ISOETES MELANOSPORA Engelm. in Oaks of United States, 2: (nota).
 1877; Trans. St. Louis Acad. Sci. 3: 395. 1877; l.c., 4: 383.
 1882; Baker, Jour. Bot. 18: 69. 1880; Motel. & Vendr., Actes Soc. Linn. Bord., 36: 359. 1883; Chapman, Fl. Southern United States, ed. 2, 672. 1889; Small, Fl. Southeastern United States, 25. 1903; Pfeiffer, Ann. Mo. Bot. Gard., 9: 134. 1922; Broun, Index N. Amer. Ferns, 102. 1938; Reed, Bol. Soc. Brot., 2a ser., 27: 41. 1953. Map 2 (plus).
 Syn.: Calamria melanospora (Engelm.) Kuntze, Rev. Gen. Pl., 2: 828. 1891-93.

Georgia: DeKalb Co.: Stone Mt. (matured in lab.). April 17, 1891. L.M.Underwood. (DUKE-61817); raised from plants collected on Stone Mt. 1898. Henry Eggert. (U.Minn-55736); in shallow depressions on the summit of little Stone Mt. May 15, 1897. Biltmore Herb. 4264B. (U.NC-94208; U.Minn-55737); Stone Mt. Nov. 14, 1915. W.G.Webb. (UGa-11230; DUKE-32561); shallow pool in granite, summit of Stone Mt. Dec. 8, 1935. Pyron & McVaugh 355. (UGa-16385 and 18177); in shallow mud puddle on summit of Stone Mt. Aug. 18, 1936. D.S.Correrell 6584. (UGa-15703; DUKE-6584; US; REED); in shallow pools on granite, associated with Amphianthus, Stone Mt. Mar. 5, 1939. Pyron 132. (UGa-17915); growing submerged in shallow pools of water on bare granite surface of summit of Stone Mt. Mar. 28, 1950. J.Hansen 2134. (UGa-52353); in mud and water of shallow excavations in granite rock on summit of Mt. Arabia, 3 mi. S of Lithonia. Sept. 10, 1937. D.S.Correrell 8390. (DUKE-42160; US); Mar. 16, 1939. F.J.Hermann 10173. (US); Apr. 19, 1947. H.R.Totten. (U.NC-29488); Apr. 21, 1947. A.J.Sharp & Norman Russell 2457. (U.Tenn); Apr. 19, 1956. W.D.Burbanck & F.H.Bormann. (U.NC-138246; UWVa; US; REED; SABC 1401, 15th Dist.); Rock Chapel Quarry near Lithonia. Don Eyles. (No date). (UGa-16454; REED).

South Carolina: Lancaster Co.: Granite outcrop, Forty Acre Rock, 9 mi. N of Kershaw. April 15, 1957. H.E.Ahles 23110 & J.G.Haesloop. (U.NC; REED).

4. ISOETES BUTLERİ Engelm., Bot. Gaz. 3: 1. 1878; Baker, Jour. Bot. 18: 105. 1880; Broun, Index N. Amer. Ferns, 99. 1938; Reed, Bol. Soc. Brot., 2a ser., 27: 18. 1953. Map 3B(dots).
Syn.: Calamaria butleri (Engelm.) Kuntze, Rev. Gen. Pl. 2: 828. 1891-93; Isoetes arkansasa Engelm., in sched. (Penn. State herb.); Isoetes butleri var. immaculata Engelm., Trans. St. Louis Acad. Sci. 4: 388. 1882; Isoetes butleri forma immaculata (Engelm.) Clute, Fern Allies, 258. 1905; Fern Bull. 16: 54. 1909.

Alabama: Franklin Co.: Small flat cedar glade just N of Isbell. April 25, 1942. Roland M. Harper 3877. (US-originally label-I. virginica, but look more like I. butleri).

Arkansas: Carroll Co.: Limestone glade, 3.7 mi. W of Green Forest. Apr. 18, 1940. N.C.Fassett 20585. (U.Wisc); Conway Co.: Petit Jean Mt., Morrilton P.O. July 4, 1955. Jewel E.Moore 969 and May 21, 1955. Jewel E. Moore 486. (U.Tenn); Logan Co.: Seepy glade, Magazine Mt., Ozark Nat. Forest, elev. 2800 ft. May 9, 1942. Delzie Demaree 22849. (U.Minn-379706); Saline Co.: Bauxite Glades, near Bauxite, elev. 280 ft. May 17, 1942. Delzie Demaree 23029. (US); Benton Co.: "Martins Bluff", sandstone cliffs above White River, 15 mi. NE of Fayetteville, elev. 1000-1200 ft., Ozark Plateau. May 22, 1942. D.M.Moore 400-257. (U.Wisc.).

Missouri: Jefferson Co.: Stoney Hills. May 26, 1891. H.Eggert. (U.Minn-55634 and 55636; var. immaculata Engelm., U.Minn-55635 and 55637); May 11, 1896. H.Eggert. (U.Minn-55638); DeSoto. May 25, 1896. H.Eggert. (U.ND; TEX-38968; Cal. Acad. Sci.-183222); Montgomery Co.: St. Peter sandstone glade along Rt. 40, just E of Mineola. May 24, 1948. J.A.Steyermark 65427. (US-2126758; REED); Eagle Rock, common on limestone ledges. June 3, 1897. B.F.Bush 107. (U.Minn-55639); Jasper Co.: Limestone seepy glades, Joplin, elev. 900 ft. July 5, 1957. Delzie Demaree 39301. (US); Steyermark, l.c., p. 11, map 9. 1963) distinguished I. butleri from I. melanopoda, and indicates the following counties on the map: Lincoln, St. Louis, Jefferson, Perry, Shannon, Montgomery, Warren, Gasconade, McDonald, Barry, Stone, Taney, Ozark, Christian, Lawrence, Greene, Jasper, Bates, Dade, Cedar, Polk, Hickory, Benton, Wright and Morgan.

Tennessee: Davidson Co.: Springy places in cedar barrens, vic. Nashville, near Lavergne. April (no date). A.Gattinger. (U.Tenn, as var. immaculata Engelm.); same loc. May (no date). A.Gattinger 3212. (U.Minn-55738); same loc. Mar. 30, 1934. L.R.Hesler 116. (U.Tenn); same loc. Mar. 31, 1934. Hesler, Bold & Sharp 114. (U.Tenn.); Rutherford Co.: Wet rocky soil in cedar glade, 4 mi. NE of Lavergne. May 17, 1947. E.Quaterman. (TEX-38938); limestone barren opp. Stones River Mil. Park, N of Murfreesboro. May 16, 1959. A.J. & E.Sharp 25916. (U.Tenn); limestone barrens, 5 mi. N of Murfreesboro on Nashville highway. May 10, 1948. A.J.Sharp & A.C.Koelling 23142. (U.Tenn); Williamson Co.: Cedar glade on first road N of Rutherford Co. line, off Rt. US 41. May 11, 1952. Jesse M. Shaver 10964. (U.Tenn; REED); Hillsboro Road, 6.2 mi. S of Davidson Co. line. May 11, 1952. Jesse M. Shaver 10962. (U.Tenn); Wilson Co.: Cedar Barrens, Vesta. Apr. 22, 1936. H.K.Svensen 7749. (U.Tenn).

Kansas: Cherokee Co.: Rocky soil. May 1897. Hitchcock 1068. (US).

Oklahoma: Atoka Co.: Limestone Gap, on alkali flats. June 16, 1877. Butler. (US); other records given by Pfeiffer from this locality; Cleveland Co.: Buffalo Wallows, 3 mi. E of Norman. Apr. 27, 1934. Geo. J.Goodman 2108. (US); Comanche Co.: Craterville, Wichita Mts., in pool of water on granite boulders. Elbert L.Little, Jr. July 16, 1932. (US, as var. pallida); Choctaw Co.: G.D.Butler, in 1875. Indian Territory. (Penn State, as Isoetes arkansasa Engelm., n.sp.).

5. ISOETES MELANOPODA Gay et Dur., Bull. Soc. Bot. Fr., 11: 102. 1864; Engelm., Bot. Gaz. 3: 1. 1878; Baker, Jour. Bot. 18: 105. 1880; Fern Allies, 128. 1887; Motel. & Vendr., Actes Soc. Linn. Bord. 36: 372, t. 14, f. 1-3. 1883; Eaton in Gray's Manual, ed. 7, 61. 1908; Pfeiffer, Ann. Mo. Bot. Gard., 9: 149.

1922; Broun, Index N. Amer. Ferns, 102. 1938; Reed, Bol. Soc. Brot., 2a ser., 27: 40-41. 1953. Map 3A(dots).
 Syn.: Calamaria melanopoda (Gay & Dur.) Kuntze, Rev. Gen. Pl. 2: 828. 1891-93; Isoetes melanopoda var. pallida Engelm., Trans. St. Louis Acad. Sci. 4: 387. 1882; Eaton in Grays Manual, ed. 7, 61. 1908; Little, Jr., Amer. Fern Jour. 23: 94. 1933; Isoetes melanopoda forma pallida (Engelm.) Clute, Fern Allies, 260. 1905; Fernald, Rhodora 51: 103. 1949; Reed, Bol. Soc. Brot., 2a ser., 27: 41. 1953. (Texas).

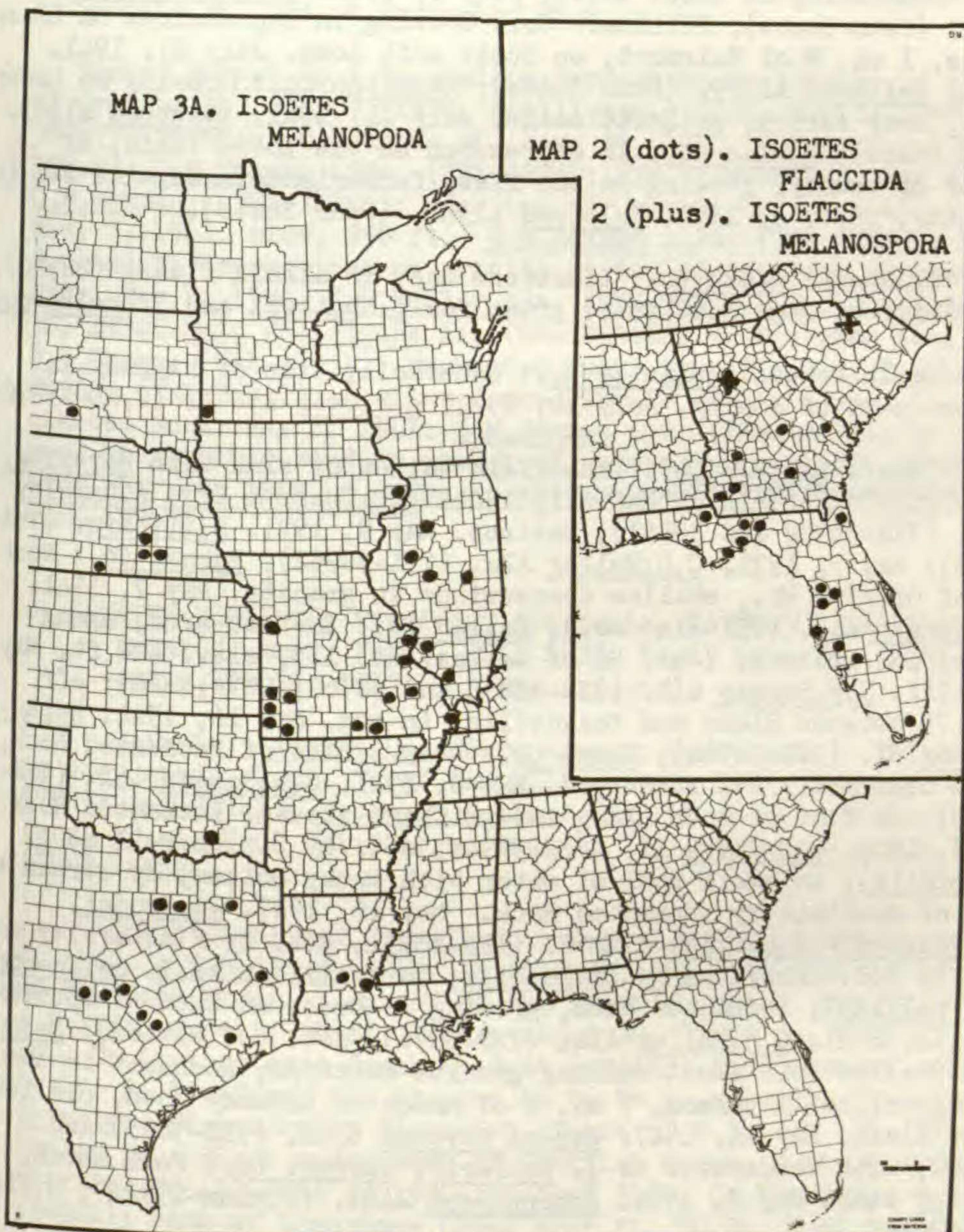
Illinois: Menard Co.: Athens. 1853. Elihu Hall. (TYPE); Athens. Nov. 1865. A.B. Seymour. (DUKE-61821); Piatt Co.: Dried-up swamp along RR, NW of Monticello. June 9, 1953. H.E. Ahles 7389. (DUKE-164705; U.Tenn; US; U.Minn-529328); St. Clair Co.: Lakes. June 10, 1882. H. Eggert. (U.Minn-55742); Stark Co.: Drying bed of shallow pond near Wady Petra. July 26, 1898. V.H. Chase. (U.Minn-406404 and 378967; Penn State); "Illinois". June 26, 1866. E. Hall. (Penn State); Jackson Co.: Along wet roadside ditch, Rt. 3, 7 mi. SW of Murphysboro. June 13, 1955. Robt. H. Mohlenbrock, Jr. 5385. (US); in inundated ditch, 3 mi. S of junction of Rt. 3 and 144, 1 mi. S of Worthen Bayou. June 13, 1955. Robt. H. Mohlenbrock, Jr. (Amer. Fern Jour. 50: 181-184. 1960).

Iowa: Clinton Co.: Clinton on Mississippi River. 1863. Vasey. (MO; GH).

Louisiana: See C.A.Brown, Ferns and Fern-allies of Louisiana, pp. 162-163. 1942. Avoyelles Parish: Marksville. 1939. C.A.Brown & Lenz 7521 (LSU); East Baton Rouge Parish: Plains. 1939. C.A.Brown 7493. (LSU); Rapides Parish: Holloway Prairie. 1939. C.A.Brown & Lenz 7522. (LSU).

Minnesota: Rock Co.: In mud at edge of pool on quartzite outcrop, 3 mi. N of Luverne. July 8, 1945. J.W. Moore & R.M. Tryon, Jr. 17557. (U.Minn-387780; TEX-38969); 3½ mi. N of Luverne. July 8, 1945. Moore & Tryon, Jr. 17559. (U.Minn-387779); 4 mi. NNW of Luverne, corm 1-2 in. deep in wet sod at edge of pond on quartzite outcrop in a pasture. July 8, 1945. Moore & Tryon, Jr. 17882. (U.Minn-387778).

Missouri: Barton Co.: Wet sandy margins of small stream on upland prairie, 5 mi. NE of Iantha. May 5, 1955. E.J. Palmer 59761. (U.Wisc.); Jackson Co.: Low prairies, local. July 10, 1898. K.K. Mackenzie 235. (U.Minn-260855); same loc. June 2, 1897. (U.Minn-55740); low prairies, Dodson. July 17, 1900. K.K. Mackenzie. (U.Wisc-13230); Dodson. June 23, 1898. B.F. Bush 35. (US); ditches along Little Blue, E of Independence. May 24, 1896. Kenneth K. Mackenzie. (U.Conn); St. Louis Co.: Lakes, St. Louis. June 1881. H. Eggert. (U.Minn-55741); Steyermark (Flora of Missouri, pp. 10-11, map 8. 1863) indicates the following counties: Jackson, St. Louis, Washington, Mississippi, Madison, Reynolds, Oregon, Howell, Newton, Jasper, Barry and Dade.



Nebraska: Clay Co.: Growing in lowlands on Loess Plains, 3 mi. SE of Fairfield, on Scott soils. July 5, 1941. Wm. L. Tolstead 41581. (Penn State); Fillmore Co.: Growing in depressions on Loess Plains, 1 mi. W of Fairmont, on Scott soil loam. July 21, 1941. Wm. L. Tolstead 41579. (Penn State); Hamilton Co.: Growing on Loess Plain, near Aurora, on Scott soils. July 21, 1941. Tolstead 41583. (Penn State); Harlan Co.: In depression on the Loess Plain, NE corner of county, growing on mud flat, formerly covered with 2-6 in. of water. Sept. 5, 1941. Tolstead 41584. (Penn State).

Oklahoma: Atoka Co.: Limestone Gap, in alkali flats. (US; MO). See Pfeiffer, same localities given for I. butleri and I. melanopoda.

South Dakota: Mellette Co.: Waterhole, side of highway in eastern part of county. July 10, 1924. W.H. Over 15878. (U.S.D-15878; US).

Texas: Bastrop Co.: In buffalo wallow or sink with Marsilea, sandy pinelands upland. Mar. 11, 1944. B.C.Tharp & Fred A.Barkley 4013. (TEX-38958 and 38961); Bastrop. May 9, 1921. B.C.Tharp. (TEX-38965); May 7, 1931. C.H.Muller A2a. (TEX-38962); Burnet Co.: Near top of Granite Mt., shallow depressions in granite. May 7, 1941. G.M.Soxman 448. (TEX-sine no.); Dallas Co.: Low wet area, among sedges and grasses, 7 mi. SE of Dallas, Rt. 175, elev. 400 ft. May 22, 1941. G.M.Soxman 452. (TEX-38956 and 38960; UWVa; REED); off Rt. 175 between Eleum and Seagoville, in bog. May 16, 1944. Helen I. Wilfong 81. (TEX-38964); Llano Co.: Near S base of Enchanted Rock, small deep pool, 75% submerged. May 8, 1941. G.M.Soxman 451. (TEX-38959); at foot of rock along intermittent stream, Enchanted Rock. May 5, 1940. B.C.Tharp XY. (TEX-38945, det. by D.S.Corrall as I. lithophila); in small pool of water with mucky bottom, by stream at base of mountain by Enchanted Rock. May 18, 1947. Wm.Krodel, B.C.Tharp & F.A.Barkley 17T278. (TEX-38951, det. by F.A.Barkley and ver. by D.S.Corrall as I. lithophila; very similar to I. melanopoda var. pallida); Enchanted Rock, growing in brook at base of mountain. Apr. 12, 1931. C.H.Muller Ala. (TEX-38963, det. C.V.Morton); Mason Co.: Shallow soil about rolling granite outcrops, abundant in seepage at edge of small stream, 7 mi. N of Mason on Katemcy Road, old leaf bases black. May 14, 1947. Rogers McVaugh 8322. (TEX-38957 and 178402, with tendencies to I. butleri); Tarrant Co.: Fort Worth, springy bank. May 8, 1905. Robert Bebb 2485. (U.Minn-299227; U.Wisc-21365).

Isoetes lithophila Pfeiffer (Ann. Mo. Bot. Gard., 9: 135-136. 1922) is another member of the melanopoda-complex. It is very similar to I. melanopoda in many respects, as living in shallow granitic depressions on mountains (but only in Texas), the sporangium completely covered by the velum, stomata present, sporangium orbicular (to oblong) and slightly larger, ligule cordate-triangular. In several other characteristics it differs sufficiently to be kept as a separate

species in the melanopoda-complex. However, it is found in Texas in Burnet and Llano Counties associated with Isoetes melanopoda on Granite Mt. and at Enchanted Rock.

Texas: Burnet Co.: In shallow depression in granite on east slope of Granite Mt. May 9, 1914. McAllister. (TYPE: MO; NY; ISOTYPE: TEX-38967); SE base of Granite Mt. Nov. 30, 1940. G.M.Soxman 428. (TEX-38949); G.M.Soxman 428c. (TEX-38950; REED); same loc. May 5, 1941. G.M.Soxman. (TEX-38944); near top of Granite Mt. in shallow pool. Nov. 7, 1941. elev. 850 ft. G.M.Soxman 448a. (TEX-38948); Llano Co.: Growing in depressions on granite on top of mountain, Enchanted Rock. May 1, 1930. C.H.Muller A3a. (TEX-38946); Enchanted Rock. April 30, 1938. Eula Whitehouse XI. (US-1871690; REED); same loc. and date. B.C.Tharp. (TEX-38951); Enchanted Rock. May 17, 1940. B.H.Warnock 20565. (TEX-38942); shallow depression in granite, near top of Enchanted Rock. May 8, 1941. G.M.Soxman 450. (TEX-38953); in shallow pool in granitic sand in pocket of granite near summit of Enchanted Rock. May 18, 1947. B.C.Tharp, Addison Lee & Fred A. Barkley 17T305. (TEX-38943).

6. ISOETES VIRGINICA Pfeiffer, Claytonia, 3: 29-30. 1937; Broun, Index N. Amer. Ferns, 104. 1938; Reed, Bol. Soc. Brot., 2a ser., 27: 56. 1953. Map 4A(dots).

Georgia: Laurens Co.: Bare exposed mud flats in branch swamp, in deep shade, 2 mi. SW of Cadwell. June 3, 1947. McVaugh 8620. (TEX-178239 and 38941); Macon Co.: Along edge of shallow pond, F.M. Carson Farm, 15 mi. N of Oglethorpe. Aug. 4, 1941. Joseph H.Pyron 857. (DUKE-135334).

North Carolina: Caswell Co.: Bog, 1 mi. N of Frogsboro. June 4, 1960. A.E.Radford 43252. (U.NC;REED); Chatham Co.: Alluvial woods on New Hope River, 3 mi. NE of Haw River Junction. May 12, 1955. A.E.Radford 8415. (U.NC, leaves about 20, 25-28 cm. long); Columbus Co.: On Livingston's Creek at Boat Landing, near Freeman. (Spec. sent to Dr. N. Pfeiffer, who thought it to be I. eatoni). Miss Gertrude Grimsley. Discussed by Blomquist, Ferns of N.C., p. 123. 1934; Duplin Co.: Black muddy bank of Rockfish Creek, 2 mi. W of Wallace near Rt. NC 41. June 1, 1950. Radford 5138. (U.NC-49260; U.Minn-536024); bank of Limestone Creek near Rt. NC 24, W of Beulahville. Sept. 13, 1949. Radford 5056. (U.NC-50276); Moore Co.: Banks of Little River, E of Thaggards Pond, April 22, 1950. Radford 5059. (U.NC-50467; U.Minn-536035); New Hanover Co.: From a stream near Wilmington. Dec. 18, 1939. Mrs. J.H.Cummings. (TEX-38940; U.NC-12972). (Spec. labelled I. engelmannii A.Br.); Pender Co.: Sluggish stream, 3 mi. E of Rt. NC 53 and Rt. US 421 Intersection. Apr. 23, 1949. Radford 4007. (U.NC-50319; Moores Creek near Rt. NC 53. Apr. 23, 1949. Radford 4012. (U.NC-50280 and 47761); Sampson Co.: Muddy bank of Six

Runs Creek near Rt. NC 24. Sept. 13, 1949. Radford 5059. (U.NC-50530); Union Co.: Oak-hickory woods, 0.7 mi. W of New Salem on Rt. NC 218. May 4, 1956. Radford 10599. (U.NC;REED).

South Carolina: Darlington Co.: Black Creek swamp about 100 yards from Old Lyde Bridge place. Oct. 18, 1941. B.E.Smith. (U.NC-23724); in edge of lake, Hartsville. Oct. 24, 1941. B.E.Smith. (U.NC-23719); growing entirely submerged in Prestwood Lake near Coker College boathouse, Hartsville. Feb. 13, 1939. Velma Matthews. (U.NC-8398); Prestwood Lake, Hartsville. Apr. 3, 1939. W.C.Hewitt. (U.NC-11153); York Co.: Stream, 1.5 mi. WNW of junction Rt. SC 82 and SC 72, Smiths. Apr. 14, 1957. Harry E. Ahles 22973 and John G. Haesloop. (U.NC).

Virginia: Augusta Co.: 1936. Lloyd G. Carr & E.T.Wherry. (TYPE); marsh, 3.5 mi. SW of Stuarts Draft. June 5-6, 1938. E.P.Killip 32544. (TYPE loc.). (US); Page Co.: In small drying muddy pool, elev. 3500 ft. Shenandoah Nat. Park, Big Meadows. July 21, 1945. N.C.Fassett 22309. (U.Wisc.;REED); Prince Edward Co.: Small drainage ditch in open woodland. May 13, 1938. A.B.Massey & Edith Stevens. (Pfeiffer, Bull. Torr. Bot. Club, 66: 413. 1939).

7. ISOETES PIEDMONTANA (Pfeiffer) Reed, comb. nov. Map 4B(dots).

Syn.: Isoetes virginica var. piedmontana Pfeiffer, Bull. Torr. Bot. Club, 66: 411. 1939; Reed, Bol. Soc. Brot., 2a ser., 27: 56. 1953.

The anatomical and ecological characteristics of this species link it with the melanopoda-melanospora-butleri-lithophila-complex rather than to the engelmannii-virginica-flaccida-complex. It is confined to granitic situations, similar to I. melanopoda, I. lithophila and some specimens of I. melanopoda. In the southeast this species seems to be the expression of I. melanopoda. I have been unable to identify any specimens from east of the Mississippi River as I. melanopoda, even though several collections have had this annotation.

Georgia: Barrow Co.: Shallow pools on flat granite rocks near Parks Mill, 1.5 mi. N of Auburn. Mar. 17, 1937. Pyron & McVaugh 1352. (UGa-13856; REED); shallow depressions in granite, Parks Mill, 2 mi. NW of Auburn. Apr. 3, 1938. Pyron & McVaugh 2414. (UGa-16389); shallow pools on flat granite rocks, just S of Winder. Mar. 17, 1937. Pyron & McVaugh 1339. (UGa-13855); muddy pools over flat granite rock, 1 mi. W of Winder. Mar. 17, 1937. Pyron & McVaugh 1341. (UGa-13817); Columbia Co.: Moist soil on flat granite rock, "Heggie Rock", emersed, 8 mi. E of Appling. May 23, 1937. Pyron & McVaugh 1676. (UGa-14335;REED); Douglas Co.: Moist soil on flat granite rock, emersed, 0.2 mi. W of Douglasville. May 30, 1937. Pyron & McVaugh

1728. (UGa-14286; Butler Univ.-35509; REED); Elbert Co.: Bog in flatwoods, 1.2 mi. N of Fortsonia, farm of Guy T. Bell, Piedmont Province. May 3, 1956. G.W.McDowell. (UGa-52355); mud on edge of flat granite exposure, 2.4 mi. SE of Elberton. May 6, 1954. G.W.McDowell. (UGa-50696); Greene Co.: Shallow pools of granite outcrop, "Flatrock", 9 mi. SE of Greensboro. May 16, 1937. Pyron & McVaugh 1645. (UGa-14196; REED); same loc., Feb. 1, 1939. Pyron 125. (UGa-17783); Gwinnett Co.: Submerged in shallow pool in granite outcrop, about 1 mi. W of Loganville. Mar. 24, 1949. H.E.Moore & G.H.M.Lawrence 600. (Univ. Coimbra; UGa-52354); SW of Grayson. May 3, 1928. E.T.Wherry. (US); Heard Co.: Shallow soil about granite outcrops, 4 mi. SW of Franklin. Apr. 30, 1938. Pyron & McVaugh 2835. (UGa-16376); same loc. and date. Pyron & McVaugh 2840. (UGa-16387); same loc., May 30, 1937. Pyron & McVaugh 1753. (UGa-14370); Hancock Co.: Shallow vernal pools about granite outcrops, 3 mi. SE of Sparta. Mar. 14, 1939. McVaugh 4663. (DUKE-68053); same loc., Feb. 13, 1938. Pyron & McVaugh 2061. (UGa-15774; REED); Newton Co.: In bogs with Xyris on edge of granite-gneiss outcrop, near Oxford. Mar. 21, 1937. Don Eyles 957. (UGa-156711); in sluggish streamlet, on granite outcrop, 4 mi. N of Covington. Mar. 14, 1939. F.J.Hermann 10166. (US); Oglethorpe Co.: Shallow soil about granite outcrops, Echols Mill, 12 mi. NE of Lexington. Apr. 4, 1938. Pyron & McVaugh 2422. (UGa-16386, 16375; REED); same loc., May 13, 1938. Pyron & McVaugh 2869. (TYPE, UGa-16384); Pike Co.: Shallow soil about granite outcrop, 4 mi. NW of Concord. Mar. 23, 1938. Pyron & McVaugh 2293. (UGa-16377); same loc., Oct. 24, 1937. Pyron & McVaugh 1931. (UGa-14625, basal face of megaspore with shallow rounded ridges, scarcely anastomosing); Putman Co.: Shallow soil about granite outcrops, 13 mi. E of Eatonton. Apr. 2, 1938. Pyron & McVaugh 2406. (UGa-16388); same loc., Feb. 20, 1938. Pyron & McVaugh 2073. (UGa-15763); Walton Co.: Shallow pools on flat granite rocks, 1 mi. E of Logansville. Apr. 19, 1936. Pyron & McVaugh 822. (UGa-11231); same loc., Mar. 15, 1936. Pyron & McVaugh 484. (UGa-11291); same loc., Dec. 8, 1935. Pyron & McVaugh 353. (U.Minn-356441; U.ND; US; Butler Univ.-58370; UGa-18206); same loc., Pyron & McVaugh 352. (UGa-18307); Warren Co.: Muddy places about granite outcrops, Cedar Rock Quarry, 5 mi. E of Camak. Feb. 13, 1938. Pyron & McVaugh 2050. (UGa-15805).

North Carolina: Franklin Co.: Granite barrens, 2.7 mi. W of Nash-Franklin Co. line, on Rt. NC 56. Apr. 25, 1957. H.E.Ahles & J. Haesloop 23834. (U.NC; REED); Cedar Rocks, between Louisburg and Castalia, in shallow sandy pool. May 30, 1946. H.J.Oosting 2301 and L.E.Anderson. (DUKE-115195; U.Minn-405867); Rowan Co.: In a shallow pool on granite, 0.4 mi. SW of Shupings Mill. Apr. 12, 1957. James H. Horton 826. (U.NC-102226); on granite, 4 mi. SE of Salisbury. Apr. 21, 1956. Radford 10240. (U.NC; REED); Salisbury. May 30, 1895. W.W. Ashe. (U.NC-10159); shallow stream on granite, Bringle Ferry Road, 0.3 mi. ESE of Dunns Mt. Road. Mar. 11, 1957. James H. Horton 645.

(DUKE-143014; U.NC-102227; REED); Wake Co.: Seepage slope on granite near Little River, 2 mi. NE of Rolesville. Apr. 21, 1955. Radford 8346. (U.NC-86811, leaves 10-12 cm., 25-30 leaves per plant); granite outcrop at Mitchells Mill, 2 mi. E of Rolesville near Little River. Apr. 23, 1957. Robt. F. Britt 482. (U.NC); same loc. and date. P.J. Crutchfield 543. (U.NC); same loc. Apr. 22, 1958. Patrick W. Carlton 218. (U.NC).

South Carolina: Spartanburg Co.: Wet soil over granite depressions, 3 mi. SE of Greer. May 11, 1939. Stanley A. Cain. (U.Tenn-936; REED; originally labelled I. butleri).

8. ISOETES RIPARIA Engelm. ex A.Br., Flora, 29: 178. 1846; Amer. Jour. Arts & Sci. II, 3: 53. 1847; Gray's Manual, ed. 5, 676. 1867; Baker, Jour. Bot. 18: 69. 1880; Pfeiffer, Ann. Mo. Bot. Gard., 9: 181. 1922; Broun, Index N. Amer. Ferns, 103. 1939 (partim); Proctor, Amer. Fern Jour. 39(3): 86-87. 1949; l.c., 39(4): 110-121. 1949; Reed, Bol. Soc. Brot., 2a ser., 27: 45-46. 1953. Map 5.

Syn.: Calamaria riparia (Engelm.) Kuntze, Rev. Gen. Pl., 2: 828. 1891-93; Isoetes foveolata var. plenospora Eaton, Rhodora 5: 280. 1903 (partim).

8A. ISOETES RIPARIA Engelm. ex A.Br., var. RIPARIA; Proctor, Amer. Fern Jour. 39: 119-121. 1949; Reed, Bol. Soc. Brot., 2a ser., 27: 46. 1953. Map 5A(dots).

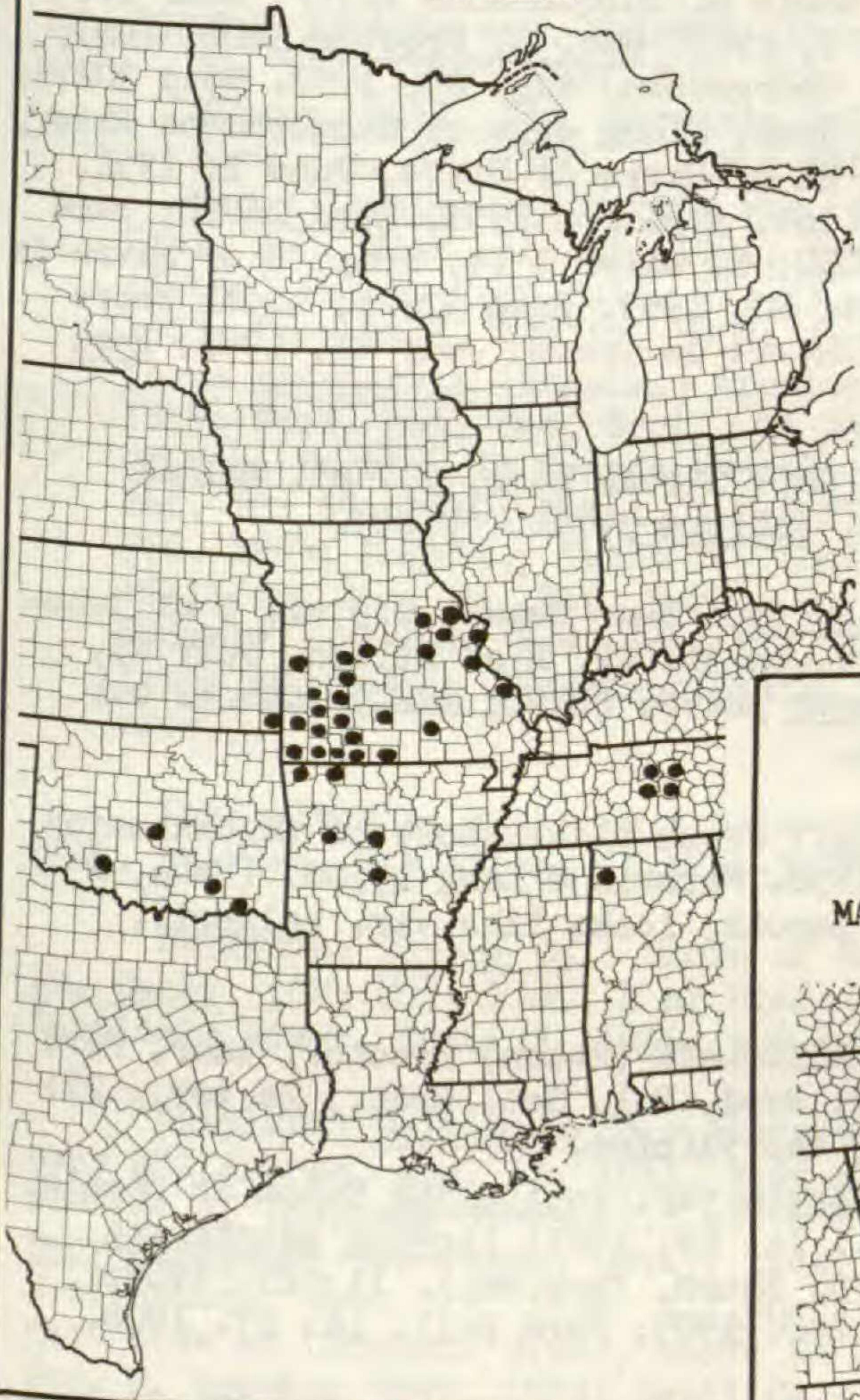
Syn.: Isoetes riparia var. typica Proctor, Amer. Fern Jour. 39: 119-121. 1949.

Pennsylvania: Philadelphia. 1866. Ex Herb. Engelmann. (DUKE-61812; Delaware River off Chester. Aug. 1894. A.B. Seymour. (DUKE-61812; Aug. 1, 1895. T.C. Palmer. (U.Conn); Aug. 1, 1896. T.C. Palmer. (U.Minn-55754); Perry Co.: In Newport Reservoir, 3 mi. NE of Newport. May 26, 1964. Reed 67057; Juniata Co.: In reservoir on East Licking Creek, Clearview, 6 mi. SW of Mifflin. May 26, 1964. Reed 66982; Lycoming Co.: Edge of water, emersed in water, 2 mi. S of Muncy, Susquehanna River, east bank. July 23, 1951. W.E. Manning. (Bucknell U.; REED).

Delaware: New Castle Co.: River Thone, Hollyoak. June 22, 1896. E.Tatnall. (U.Conn, macrospores approach I. macrospora); shore of Delaware River. 1865. Wm. M. Canby. (GH; US); Claymont, river shore. June 22, 1896. A. Commons. (GH; ANSP); gravelly shore of Delaware River between high tides, near Wilmington. July 11, 1866. A. Commons. (US).

Maryland: Baltimore City: Edge of pond at Montebello Reservoir, plentiful here. Sept. 1958. Reed 41499 (polygamous); in

MAP 3B. ISOETES
BUTLERI



MAP 4A. ISOETES
VIRGINICA



MAP 4B. ISOETES
PIEDMONTANA



2 ft. of water, edge of Montebello Filtration Reservoir. July 18, 1961. Reed 51265; Baltimore Co.: Crook Road at Bird River Beach, along Bird River, tidal shore. July 22, 1961. Reed 51412; along tidal shore near mouth of Gunpowder River near Bird River. July 22, 1961. Reed 51413 and 51414; Cecil Co.: Between tide levels, gravelly and stoney, east shore of Susquehanna River, near its mouth at Frenchtown. Sept. 7, 1948. Geo. R. Proctor 3606. (US); along Sassafras River near Georgetown. Aug. 23, 1952. Reed 30275; Harford Co.: Water 1-2 ft. deep, along edge of Susquehanna River, at head of Chesapeake Bay, SE of Havre de Grace. June 1, 1951. Reed 24897 and 24898; same loc. Aug. 16, 1951. Reed 26790; same loc. Dec. 1, 1961. Reed 28030; in water 1 ft. deep, S of Havre de Grace, Chesapeake Bay. Sept. 20, 1953. Reed 32925; tidal shore along Chesapeake Bay, S of Havre de Grace. July 21, 1961. Reed 51403 and 51405.

North Carolina: Pitt Co.: Stream bank, 2.7 mi. NNE of Grimesville. Aug. 10, 1958. Radford 39702. (U.NC).

South Carolina: Dillon Co.: Bear Swamp, 0.3 mi. S of junction of Rt. 22 and Rt. SC 9, on Rt. 22, E of Dillon. July 25, 1957. H.E. Ahles & R.S. Leisner 32295. (U.NC; REED). Checks out very close to var. riparia.

Virginia: New Kent Co.: Fresh tidal shore of Chickahominy River, Lanexa, Virg. May 1938. Fernald & Long 13508. (UWVa, 2 sheets, androspores only, smooth; looks like var. palmeri).

8B. ISOETES RIPARIA VAR. RETICULATA (Eaton) Proctor, Amer. Fern Jour. 39: 119. 1949; Reed, Bol. Soc. Brot., 2a ser., 27: 46. 1953. Map 5A(plus)

Syn.: Isoetes saccharata var. reticulata Eaton in Steele, Proc. Biol. Soc. Wash., 14: 49. 1901; Isoetes saccharata forma reticulata (Eaton) Eaton, Fern Bull. 11: 25. 1903; Clute, Fern Allies, p. 260. 1905; Fern Bull. 16: 57. 1908.

District of Columbia: Tidal beach opposite Navy Yard, Anacostia River, Washington. Sept. 1, 1900. E.S. Steele. (GH; U.Minn-55757 and 55753).

Virginia: Four Mile Run near Alexandria, abundant between tidal limits. July 12, 1905. I. Tidestrom. (GH, labelled I. saccharata); Fairfax Co.: Tidal shore of Potomac River, in very fine sand or clay rather than mud, New Alexandria. Oct. 20, 1929. S.F. Blake 11088. (U.Conn; REED); mouth of Dogue Creek, below Mt. Vernon. July 2, 1933. F.M. Uhler & A.L. Nelson. (Fish & Wildlife

Research, Patuxent); between tides along the Potomac River at the north end of Alexandria. Sept. 5, 1938. Neil Hotchkiss 6038. (Fish & Wildlife Research, Patuxent); near Washington. May 15, 1906. H.H.York. (TEX-38936).

8C. ISOETES RIPARIA var. PALMERI (Eaton) Proctor, Amer. Fern Jour. 39: 119. 1949; Reed, Bol. Soc. Brot., 2a ser., 27: 45. 1953; Massey, Bull. 256, Virginia Polytechnic Institute, Agr. Ext. Serv., p. 67. 1960. Map 5B(dots.).

Syn.: Isoetes saccharata var. palmeri Eaton in Steele, Proc. Biol. Soc. Wash. 14: 49. 1901; Isoetes saccharata forma palmeri (Eaton) Eaton, Fern Bull. 11: 25. 1903; Clute, Fern Allies, 260. 1905; Fern Bull. 16: 57. 1908; Isoetes riparia var. palmeri forma saccharata (Engelm.) Proctor, Amer. Fern Jour. 39: 119. 1949; Reed, Bol. Soc. Brot., 2a ser., 27: 45. 1953; Isoetes saccharata Engelm. in Gray's Manual, ed. 5, 676. 1867; Baker, Jour. Bot. 18: 69. 1880; Motel. & Vendr., Actes Soc. Linn. Bord., 36: 356. 1883; Engelm., Trans St. Louis Acad. Sci. 4: 382. 1882; Pfeiffer, Ann. Mo. Bot. Gard., 9: 179. 1922; Calamaria saccharata (Engelm.) Kuntze, Rev. Gen. Pl., 2: 828. 1891-93; Isoetes riparia forma saccharata (Engelm.) Clute, Fern Bull. 16: 57. 1908 (nom. prov.).

Pennsylvania: Bucks Co.: Delaware River. July 1886. Misses Ruth, ex Herb. G.B.Aiton. (U.Minn-55773).

Delaware: Sussex Co.: Shore of Nanticoke River. Aug. 1874. Wm. Canby. (GH; US); 1 mi. E of Blades, in mud on south shore of Nanticoke River. Sept. 5, 1936. R.R.Tatnall 3170. (GH).

Maryland: Baltimore Co.: Along shore under water, Bird River near Whitemarsh. Aug. 22, 1951. Reed 27045; Caroline Co.: Shore, ebbtide of Choptank River, 1.5 mi. N of Williston. Sept. 25, 1938. Mary J. Fisher 52. (U.Pa; UWVa); tidal bank of Choptank River, 2 mi. S of Denton. Sept. 25, 1938. E.T.Wherry. (GH); gravelly tidal shore, east side of Choptank River, above RR bridge at Denton. Sept. 6, 1947. Geo. R. Proctor 3097. (US); Cecil Co.: Coves of Elk River. Aug. 1894. A.B.Seymour. (DUKE-61811); Piney Creek Cove, Elk River. Aug. 1894. T.C.Palmer. (GH); Back Creek on Elk River. Aug. 1893. T.C.Palmer. (GH); many of the specimens from the Head of Chesapeake Bay, around Susquehanna Flats, are difficult to place exactly since the megasporangia vary tremendously, as well as the plant size, the sporangia size (in some specimens there are up to 60 leaves and the sporangia are 1 cm. long and nearly 1 cm. wide); some look like very short specimens of I. engelmannii while others resemble very long I. riparia;

along Sassafras River near Georgetown. Aug. 23, 1952. Reed 30275 (Some specimens look like f. saccharata); Town Point, Elk River. July 31, 1896. T.C.Palmer. (US); Cabin Johns Creek, Elk River. July 21, 1896. T.C.Palmer. (US); sandy shore of Northeast River, Carpenters Point, Charlestown. Sept. 17, 1926. S.F.Blake 9693. (US); among pebbles along shore of Northeast River, Lewis Shore. May 25, 1963. Reed 62099; mouth of Northeast River at Charlestown, Susquehanna Flats. July 8, 1963. Reed 64340 and 64341; Harford Co.: Bush River. June 18, 1938. E.L.Core 6737. (UWVa); on tidal mud, Gunpowder River. May 21, 1905. "S. & M." in Herb. Forrest Shreve. (U.Minn-521991); 0.5 mi. S of Havre de Grace. July 19, 1902. Geo. H. Shull 66. (GH; US); North shore of Little Gunpowder River, 13 mi. from its mouth. Sept. 3, 1902. Geo. H. Shull 305. (GH; US); along Chesapeake Bay, tidal shore, S of Havre de Grace. July 21, 1961. Reed 51404; same loc., Sept. 20, 1953. Reed 32919, 32920, 32921; Kent Co.: Lloyds Creek. Aug. 12, 1895. T.C. Palmer. (GH; U.Conn, note by Eaton, "Type of var. palmeri A.A.Eaton, probably only one of the many forms of the species"); Lloyds Creek, Sassafras River. July 26, 1896. T.C.Palmer. (U.Minn-55756); July 30, 1896. T.C.Palmer. (US); shallow water, Still Pond Creek. July 20, 1947. A.Owens. (U.Md.); Wicomico Co.: Shore of Wicomico River, 1 mi. S of Salisbury. Sept. 8, 1866. Wm. M. Canby. (GH; TYPE LOC.); on river shores near Salisbury. A.V.Smith. (Rhodora 41: 111. 1939); south shore of Longtank, $\frac{1}{4}$ mi. from Wicomico River, 2.5 mi. SW of Salisbury. Aug. 14, 1940. J.B.S.Norton. (U.Md.); Sharptown on the Nanticoke River. A.V.Smith. (Rhodora 41: 111. 1939); in gravel overlaid with mud, slightly brackish tidal shore of Nanticoke River, $\frac{1}{4}$ mi. NE of Sharpstown. Sept. 6, 1947. Geo. R. Proctor 3092. (US). Maryland Eastern Shore without exact county record: Notley Hall, Maryland. 1894. F.V.Coville 32. (US; GH; cited by Pfeiffer, p. 180; Calif. Acad. Sci. 93671).

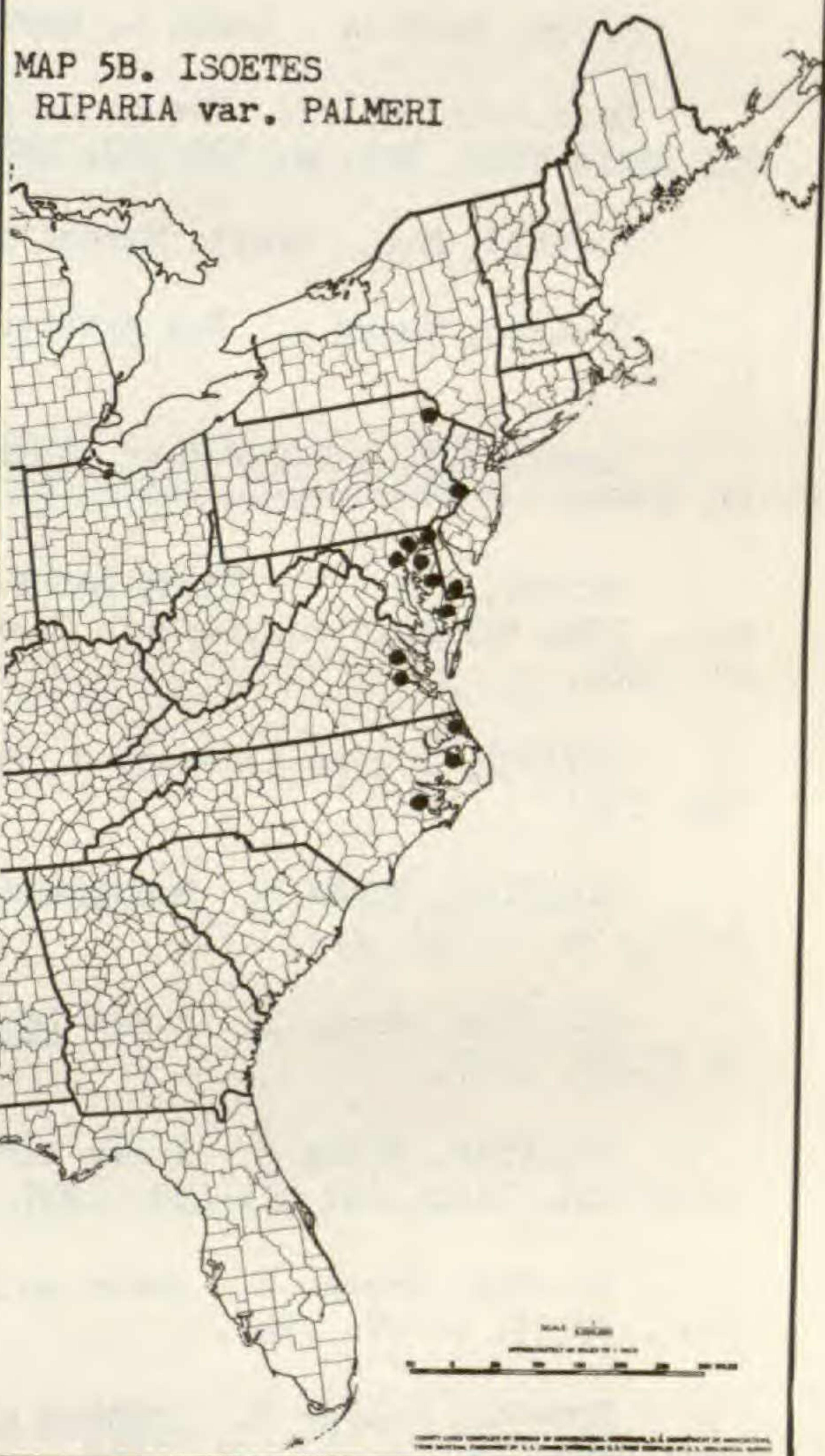
Virginia: New Kent Co.: Fresh tidal shore of Chickahominy River, Lanexa. Sept. 13, 1941. Fernald & Long 13508. (UGa-2858; US); King William Co.: Fresh tidal shore of Mattaponi River at Horse Landing near King William C.H. Oct. 14-16, 1939. Fernald & Long 11508. (US).

North Carolina: Craven Co.: Marsh near junction of Brice Creek and Trent River. June 28, 1951. Radford 5895. (U.NC); brackish marsh, near Trent River, S of New Bern. July 17, 1958. Radford 37337. (U.NC); Currituck Co.: North River, W of Powells Point. June 4, 1951. Radford 5766. (U.NC); Tyrrell Co.: Alligator River, near Ft. Landing. July 22, 1949. Radford 4624. (U.NC-50532, male); July 4, 1950. Radford 5408. (U.NC-50239, female).

MAP 5A (dots). ISOETES
RIPARIA var. RIPARIA



MAP 5B. ISOETES
RIPARIA var. PALMERI



LITERATURE CITED

- Blomquist, H.L. Ferns of North Carolina, pp. 122-124. 1934.
- Broun, Maurice Index to North American Ferns, pp. 98-104. 1938.
- Engelmann, George The genus Isoëtes in North America. Trans. St. Louis Acad. Sci. 4: 358-390. 1882.
- Fernald, M.L. Gray's Manual of Botany, 8th ed., pp. 16-19. 1950.
- Gleason, Henry A. New Britton & Brown, Illustrated Flora, 1: 9-12. 1952.
- Jones, G.N. & G.D. Fuller Vascular Plants of Illinois, pp. 10-11. 1955.
- Massey, A.B. The Ferns and Fern-allies of Virginia, 3rd. ed. Bull. 256, Virginia Polytechnic Institute, Agr. Ext. Serv., pp. 66-67. 1960.
- McVaugh, Rogers & Joseph H. Pyron Ferns of Georgia, pp. 178-185. 1951.
- Pfeiffer, Norma E. Monograph of the Isoëtaceae. Ann. Mo. Bot. Gard., 9: 79-232. Apr. 1922.
- Pfeiffer, Norma E. A new Isoëtes from Virginia. Claytonia, 3: 29-30. 1937.
- Pfeiffer, Norma E. A new variety of Isoëtes virginica. Bull. Torr. Bot. Club, 66: 411-413. 1939.
- Proctor, George R. Notes on Isoëtes in Maryland. Amer. Fern Jour. 39(3): 86-87. 1949.
- Proctor, George R. Isoëtes riparia and its variants. Amer. Fern Jour. 39(4): 110-121. 1949.
- Reed, Clyde F. The Ferns and Fern-allies of Maryland, Delaware and the District of Columbia. 1953.
- Reed, Clyde F. Index Isoëtales. Bol. Soc. Brot., 2a ser., 27: 1-72. 1953.
- Small, John K. Flora of Southeastern United States. Ed. 2, pp. 30-31. 1913.
- Steyermark, Julian A. Flora of Missouri, pp. 10-11. 1963.